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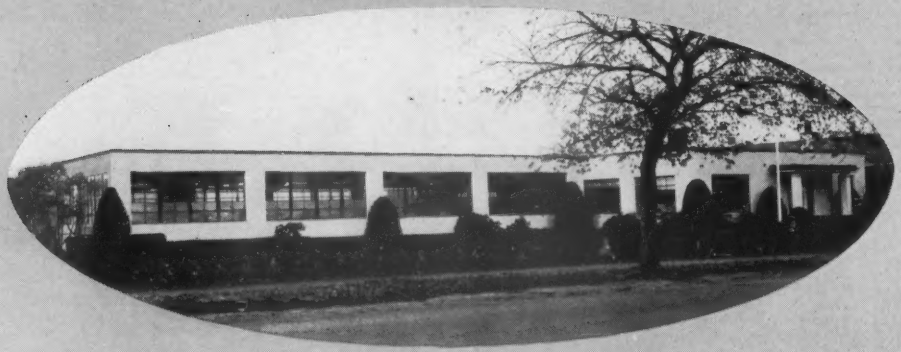

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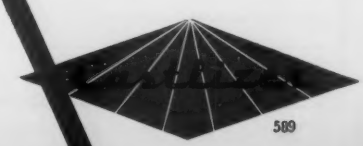

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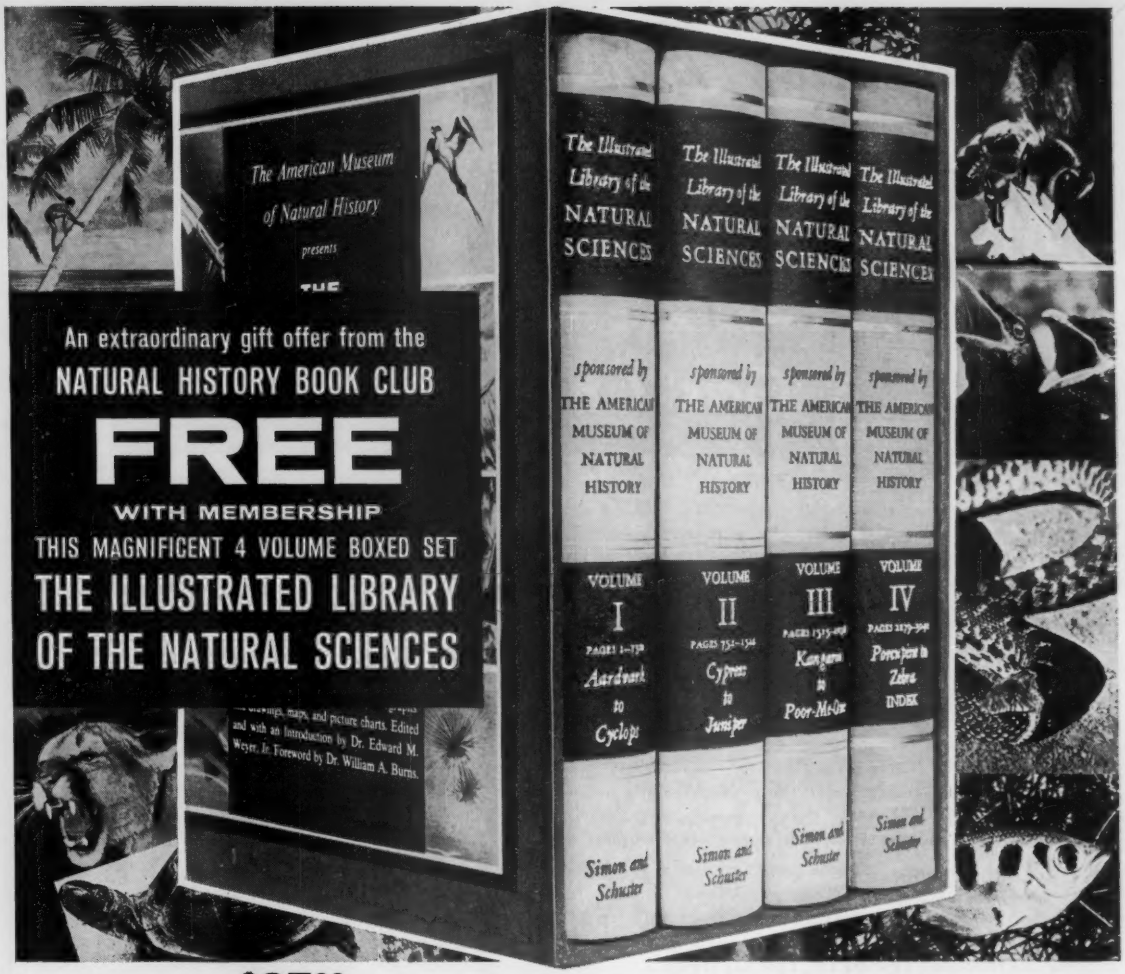

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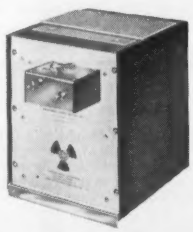

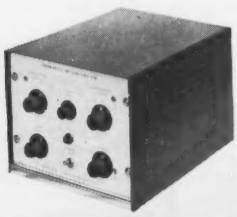

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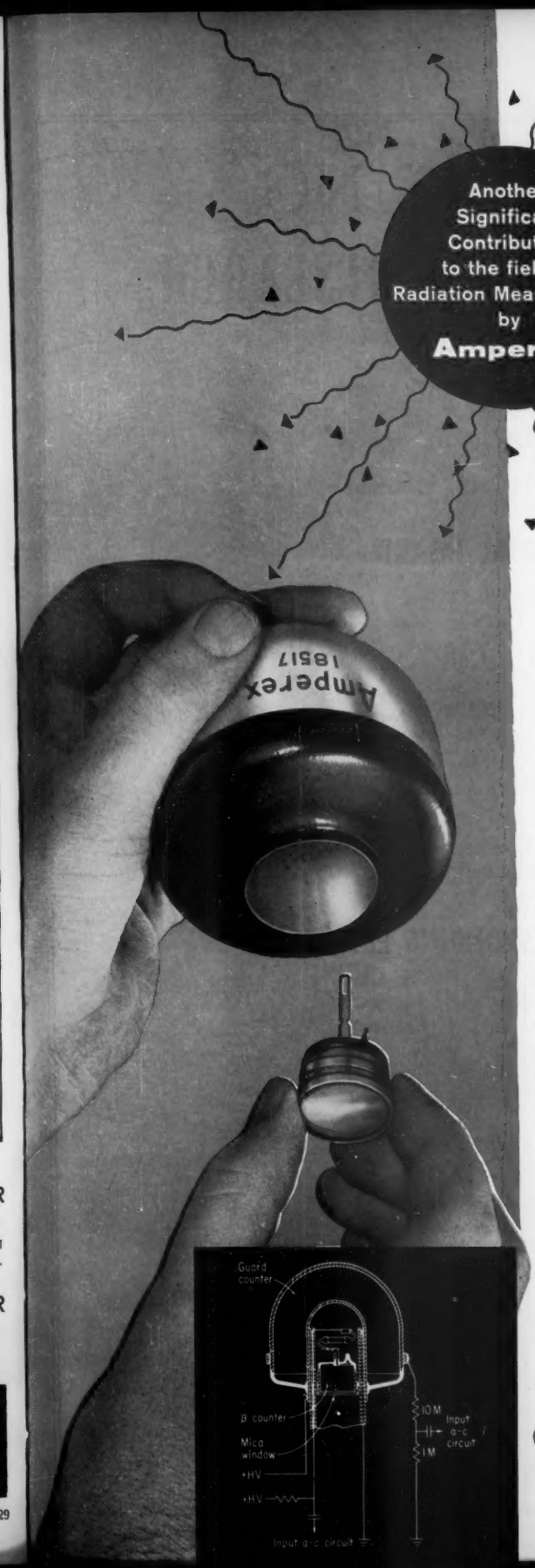

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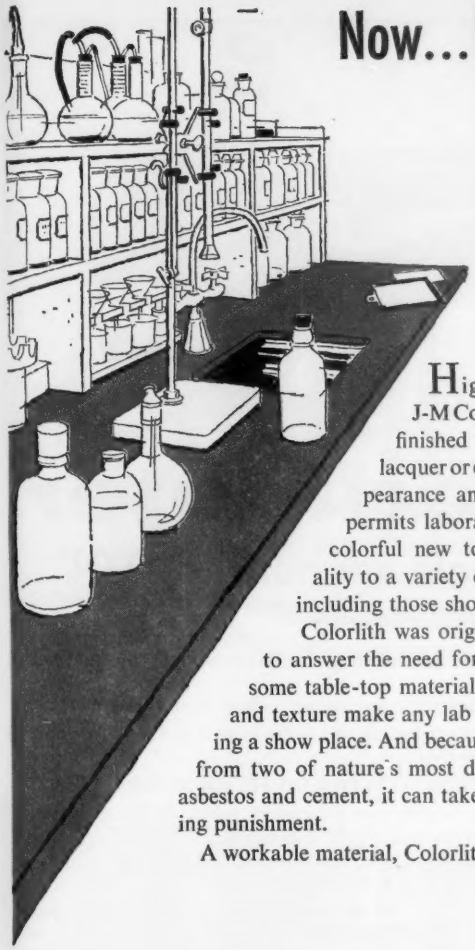

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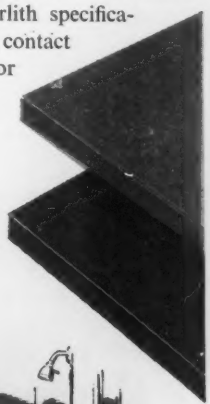

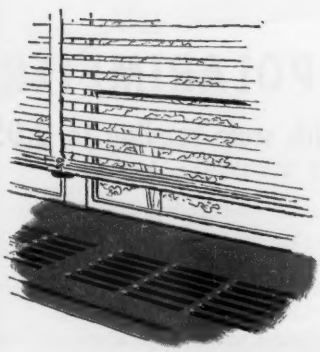

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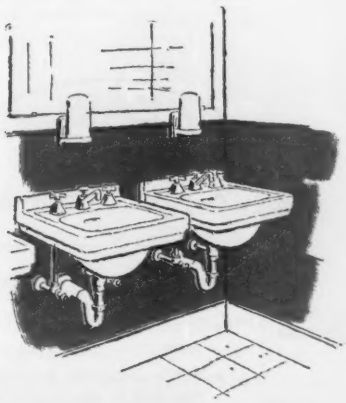

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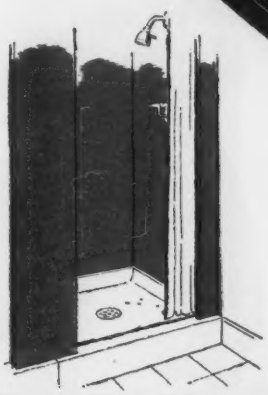

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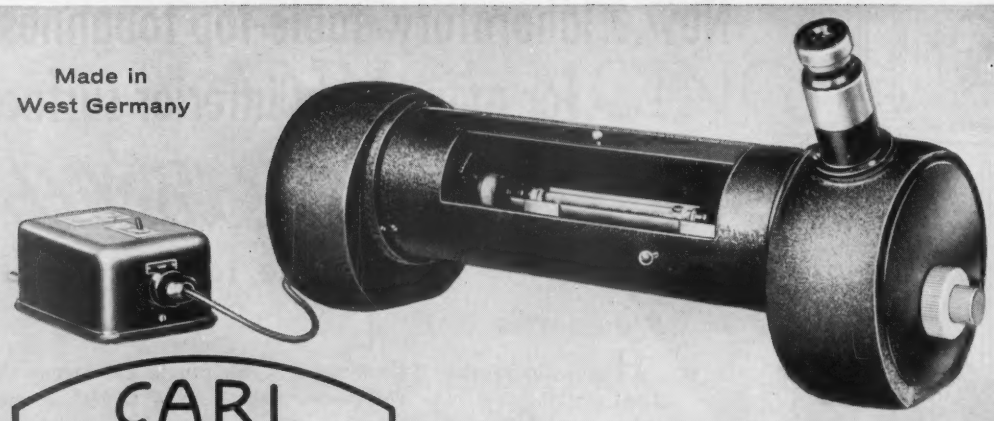

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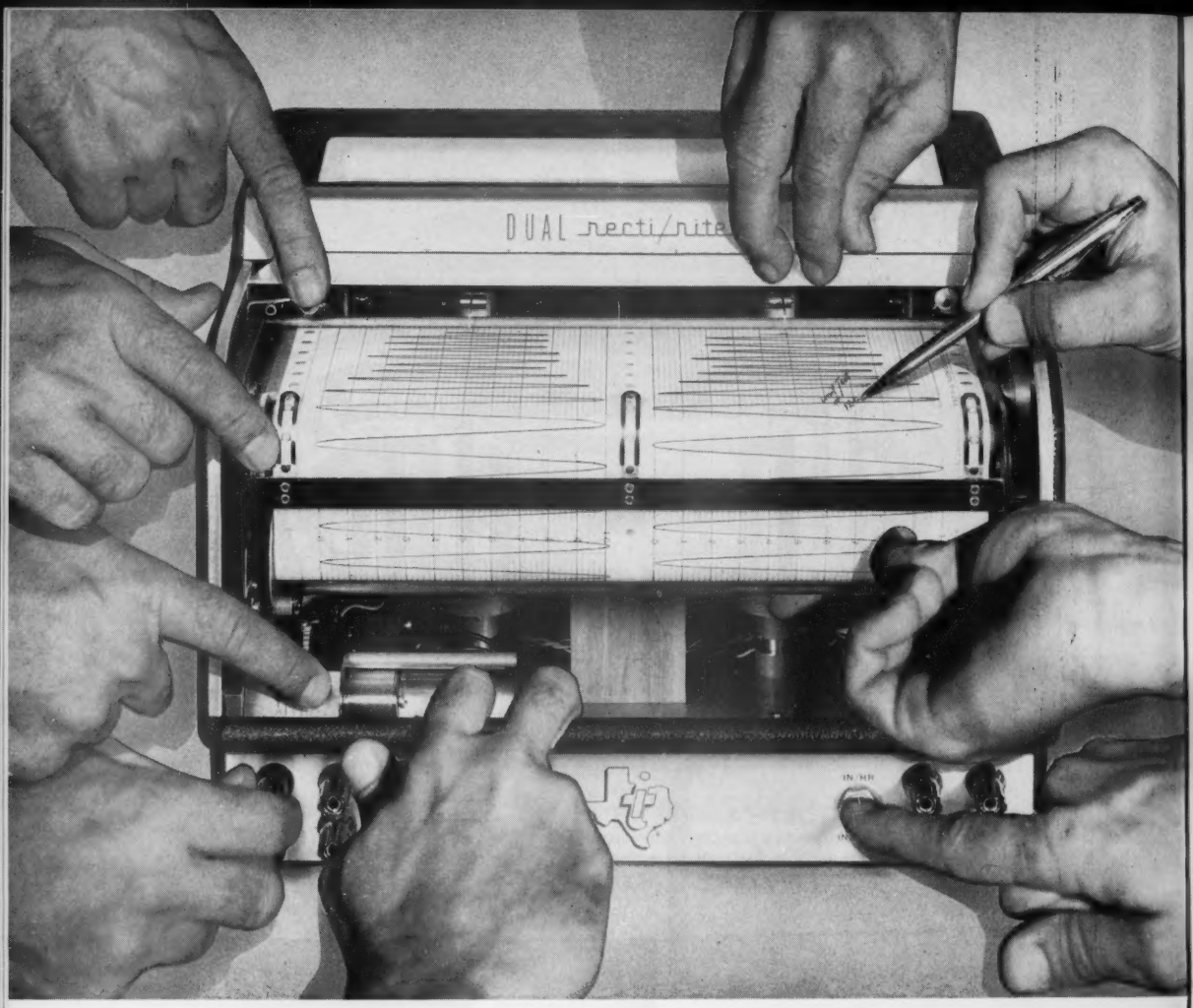

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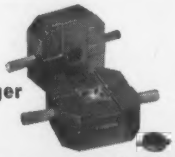

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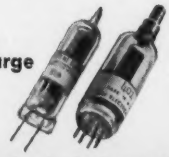

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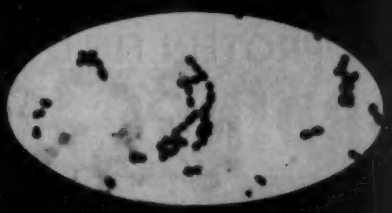

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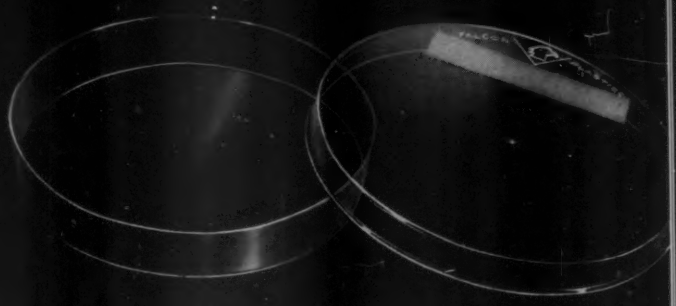

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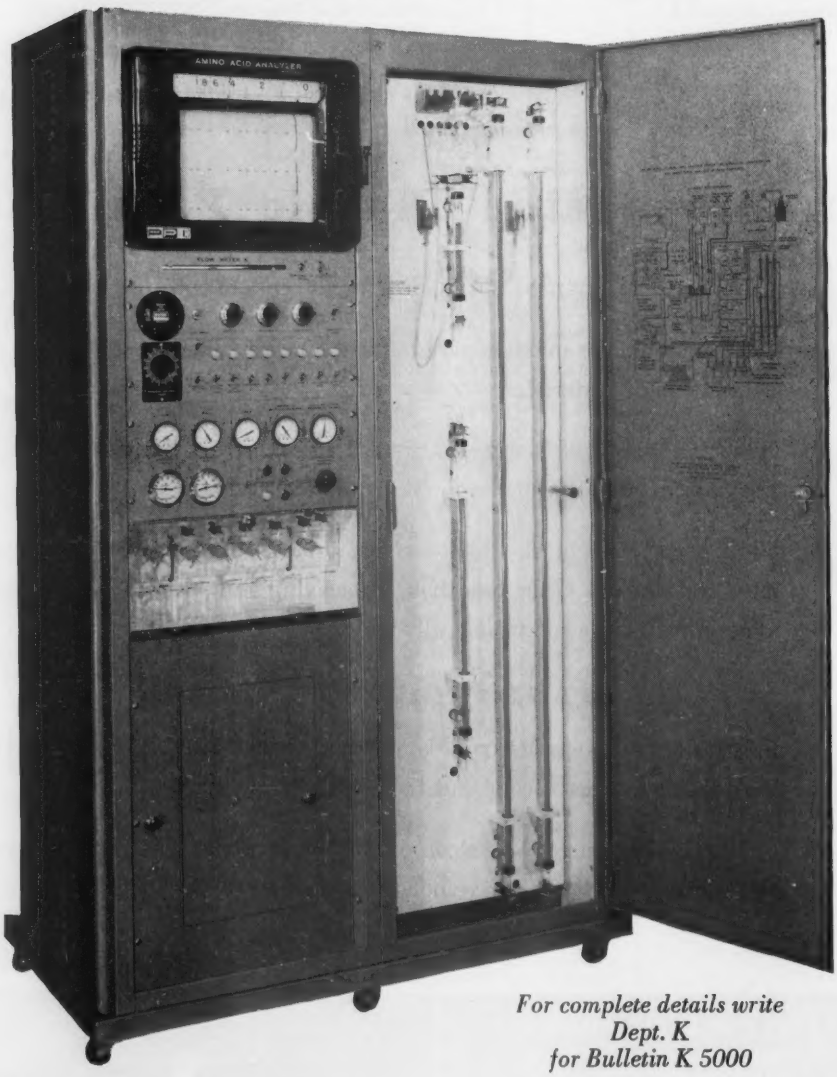

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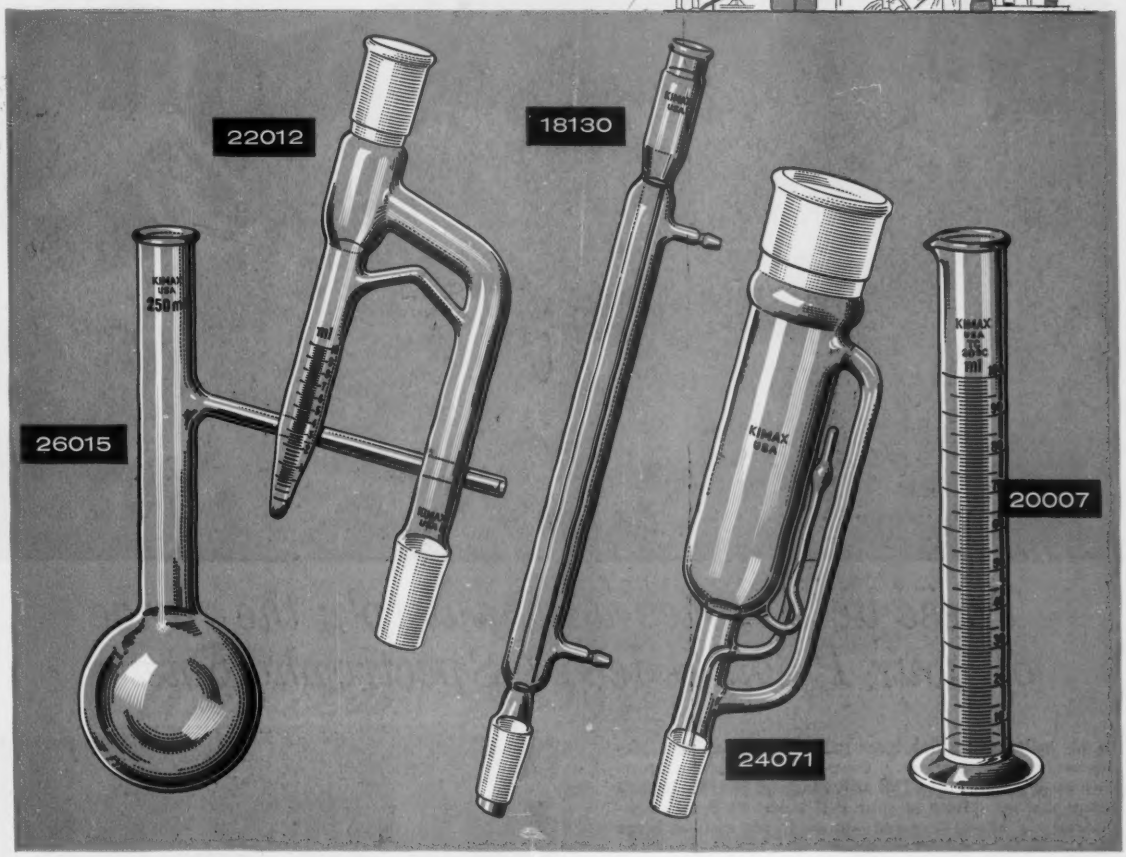

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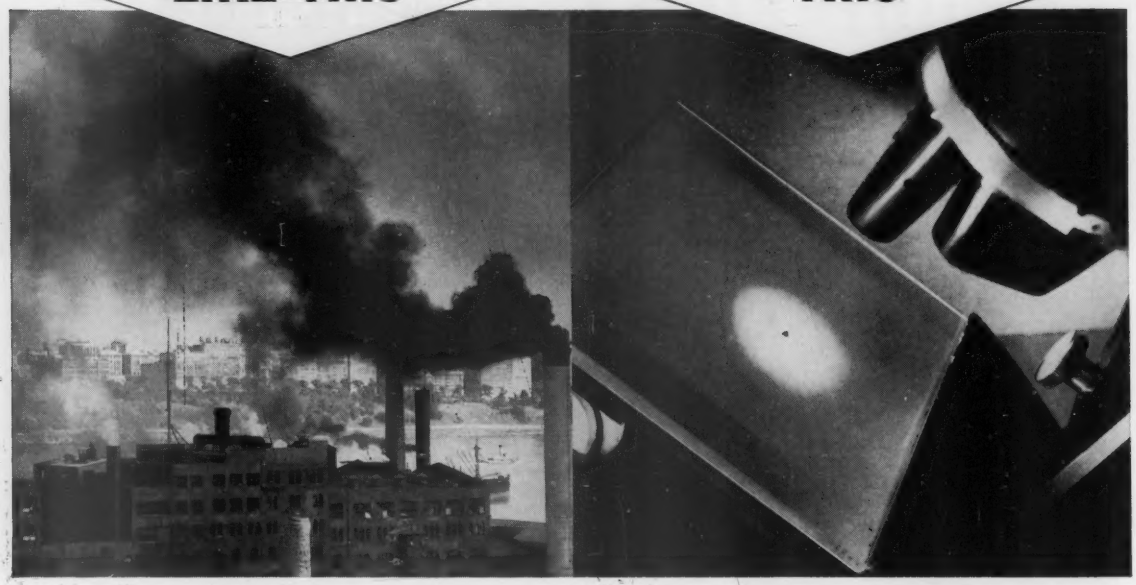

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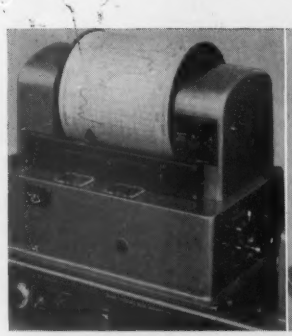

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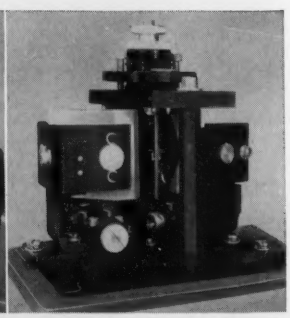

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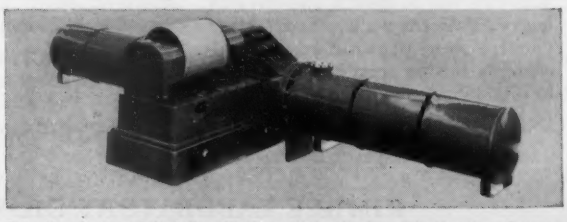

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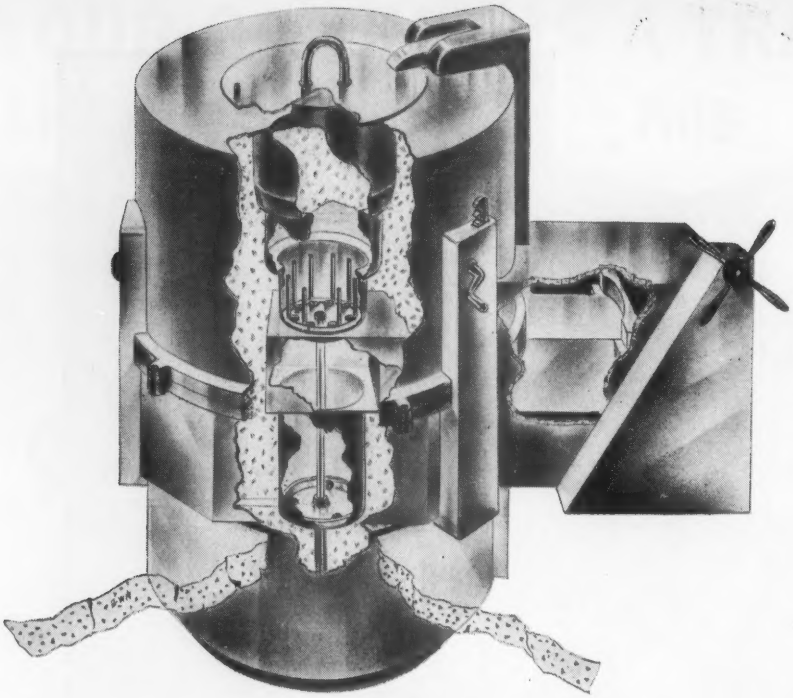

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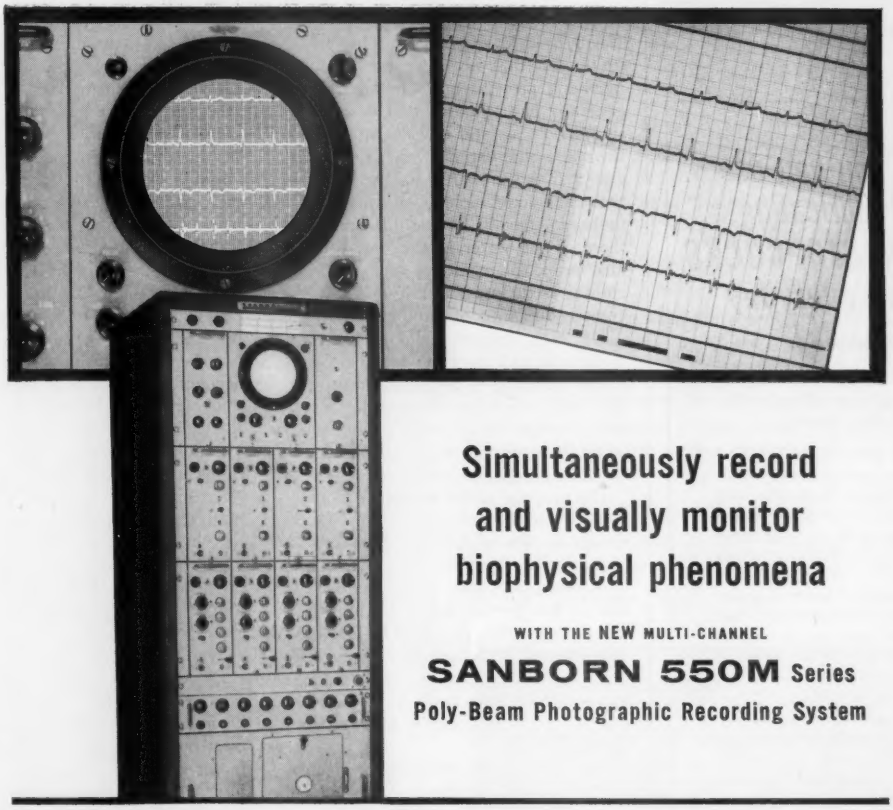

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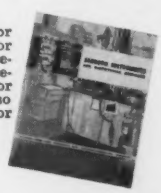

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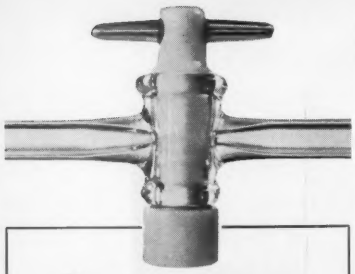

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Letters

Protein Behavior

In a recent article [*Science* **128**, 815 (1958)], I. M. Klotz admirably points up the fact that electrostatic interactions involving proteins and small ions have generally had to be treated in an oversimplified way, and he calls attention to the many observations which would suggest that the properties of the water in the immediate vicinity of the protein molecule may be rather different from those of the water in the bulk solvent. His proposal regarding the effect of an ice structure would explain the greater difficulty of protonation of an $-N(CH_3)_2$ group but, it appears, would still not solve the problem of reduced reactivity of the —SH group with Ag^+, with which he initiated the discussion. In this case, of course, there would be no change in the charge to modify the structure of the ice lattice.

The proposal seems even more troublesome when one considers the —COOH groups in the protein. In this case a charge appears on the group when the hydrogen ion is lost. Consequently, the loss of the proton would be hindered, and the apparent *pK* should be increased as compared with the expected intrinsic *pK*. There seems to be little evidence for any considerable number of —COOH groups with unexpectedly high *pK*'s in proteins.

The lack of any evidence for electrostatic effects on the titration curve of the azomercurial would still be disturbing, however—unless one assumes that the reaction with hydrogen ion is leading to displacement of the azomercurial. If this were true, there would be no change in the charge, and one would not anticipate an electrostatic effect. Such a displacement of methylmercury would have been anticipated on the basis of the results of Hughes [*Cold Spring Harbor Symposia Quant. Biol.* **14**, 79 (1949)].

JOHN W. MEHL
University of Southern California, Los Angeles

Each of the three paragraphs of Mehl's letter raises essentially one question. The responses may be grouped, therefore, into the same arrangement.

1) "Maskedness" in the behavior of —SH groups, as Mehl would undoubtedly agree, is a problem of rates rather than equilibria. For example, Ag^+ is usually taken up even by masked —SH groups of proteins if we wait long enough. In terms of my model, the explanation (clearly implied if not explicitly stated in the article) is that Ag^+ would diffuse through "ice" much more slowly than through liquid water. While no actual data are available for diffusion of Ag^+ in ice, measurements with a similar monovalent ion, Li^+ [M. Eigen and L. DeMaeyer, *Proc. Roy. Soc.* (*London*) **247A**, 505 (1958)], certainly bear this point out.

2) The most careful theoretical analyses of the titration curves of a protein with, for example, 100 carboxyl groups have limited themselves to a single intrinsic dissociation constant. The spread of the titration curves has been accounted for by the assumption that there is a variable electrostatic factor, plus necessary additional assumptions in specific cases. Clearly, if deviations from ideality are attributed to these additional factors, and if we permit the possibility of only a single intrinsic constant, we cannot possibly find more than one intrinsic constant. As I have emphasized, however, the titration curves can also be accounted for by the assumption that there is a broad spectrum of *pK*'s for the carboxyl groups.

3) The explanation suggested by Mehl is not really tenable. We have not studied the titration curve by some general method which follows gross H^+ ion uptake but rather by a special spectrophotometric method which reveals specifically the uptake of H^+ by the $(CH_3)_2N$— group of the dye, not by the mercaptide group of the protein. It is the unusual *pK* and the unexpected shape of the curve for the optical titration of this particular $(CH_3)_2N$— group which must be interpreted; a displacement mechanism postulates changes in state of a different group at the opposite end of the molecule. Furthermore, one should also recall that if the dye had been displaced from the mercaptide linkage, no optical titration could have been obtained in the first place, for as we have mentioned previously [*Arch. Biochem. Biophys.* **63**, 77 (1956)], the dye is essentially insoluble in water alone.

I. M. KLOTZ
Northwestern University, Evanston, Illinois

On Eschewing Teleology

A. J. Bernatowicz' stern admonitions [*Science* **128**, 1402 (1958)] to his biological colleagues and to all other scientists to eschew anthropomorphism and avoid even the appearance of teleological thinking (lest their students be not saved from corruption) confuses me. He wants mechanism, and thus also surely determinism, recognized as the language of science, and he wants the teacher of science not to depart from it. Does he mean *never*? Not with the student at the luncheon table? Not with his wife at the breakfast table? How rigorously must righteousness be applied? And must all scientists observe the canon? I think

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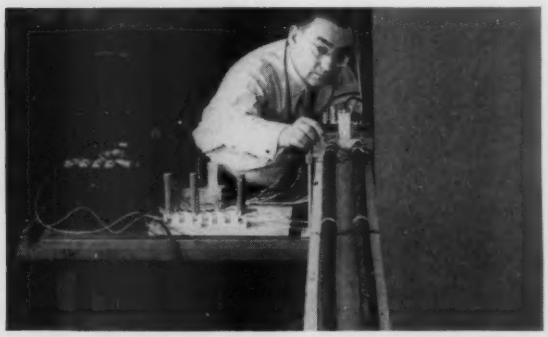

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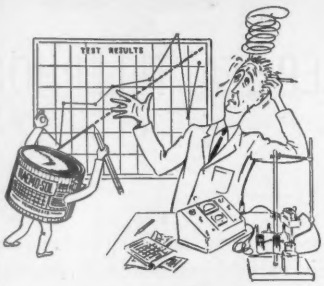

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Bernatowicz does believe just this, and I suspect that he also thinks that the scientific view of the world is the true view and that he who departs from proper deterministic language is dealing lightly with truth.

Well, the language of science is descriptive and not purposive. I am wholly in accord with Bernatowicz on that point. But, if we are talking science, I go farther where he stops short, for I note—remaining descriptive because I am being scientific—that we have here a case of one organism attacking others because these others behave differently from the one. Scientifically, all we have is a case description of an idiosyncratic organism, Bernatowicz, which does not, on the showing of his paper, represent the species but a departure from it. Is this organism quieted by this description of his behavior, or do his words suddenly seem to carry an anthropomorphic meaning? Do they say that his purpose was to convince others of his own rightness, thus ruling him out of the class of scientific organisms because he speaks in terms of purpose? If Bernatowicz wants rigor and the scientific attitude all the time, let him, a biologist, include his own conduct under the scientific rules. Was he or was he not being purposive? I think he was.

For myself, I take the use of the scientific language more lightly, less rigorously, and I am glad that most of my colleagues do too. J. J. Thomson said that a scientific activity is a policy, and he might have made his comment broader to say that all scientific activity is a policy to be accepted when it works and changed when it does not. I do not pretend to be a scientist in all my speech, nor do I want students to be. I want them to have values and purposes, to know when to escape the scientific strait jacket and also when to get a new strait jacket. There should be nothing so inflexible about science or scientific conduct or scientific language. What we want for scientists is wisdom, good judgment, the ability to speak and write English delicately and significantly, enough wisdom to break any rule when a good purpose will be supported thereby.

Urbanity never hurt a scientist yet. Using English with skill, relying on the connotations to work as they should, is less secure than the rigor of mathematics but an art capable of much greater refinement. I find in none of Bernatowicz' examples the sort of thing that should be changed if it is given in a proper scientific context. A strict adherence to his rule would eliminate entirely from scientific speech the phrase *in order that*, and that seems to me to be a preposterous suggestion. The Darwinian theory was a way of changing purposive events into descriptive, and for me (and I should hope for most students) the context of most of these disapproved sentences would be the nonpurposive, descriptive concept of natural selection.

In any event—say I, anthropomorphically purposive, and purposively anthropomorphic—let us not warp our young scientists by rigid rules. Always remembering that we do not wish for all to be alike, let us cultivate urbanity, wisdom, and flexibility. Let us help them to learn to speak and write well, clearly, freely, attractively, and differently from one another. Let us hope they can learn to think of science as a happy way of life, not as a harsh taskmaster with a code of morals dangling at his belt.

EDWIN G. BORING
Harvard University,
Cambridge, Massachusetts

In the interests of clear thinking one should certainly be wary of any statements that are unjustifiably teleological, as A. J. Bernatowicz has pointed out. Judging from his conclusions, however, I suspect that he would prefer to leave out the word *unjustifiably* in my first sentence, as would many other scientists, although not all. [See L. K. Frank, G. E. Hutchinson, W. K. Livingston, W. S. McCulloch, N. Weiner, *Ann. N.Y. Acad. Sci.* **50**, 187 (1948)].

Let me make plain at the beginning that I would agree that in many circumstances teleological language is inappropriate, implying the existence of agencies beyond our ability to observe directly. The examples quoted by Bernatowicz, I would judge, all demonstrate misapplication of teleological concepts. However, not all of them are inherently unsuited to such treatment.

What do we mean when we say that a statement is "teleological"? Do we not mean that it implies some directing or governing factor which by its nature "causes" events to follow certain observed courses? Certainly in this sense the idea of "force" or "gravitation" or "field" is, or can easily be seen as, teleological, invoking the presence of an agency which we can observe only by inference. But if we are careful to note that, for example, a "field" is a map of what we might expect to observe, then we can still use the concept of "field" at one level of explanation, without implying the existence of any incompletely defined agency.

There is a more important area of teleological thinking, however, in which the above "way out" is of no use. This is the area of biology, physiology, psychology, and other sciences of life. Let me emphasize that when one approaches these disciplines in an attempt to imitate the (in principle) rigorous methods of physics, then any use of teleological thinking is bound to go astray. But if one approaches living entities from the sys-

(Continued on page 671)

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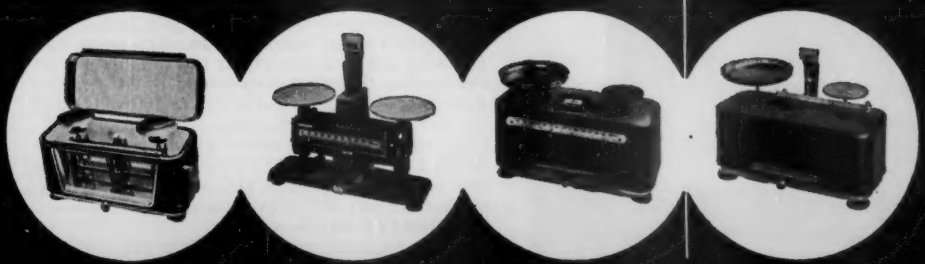

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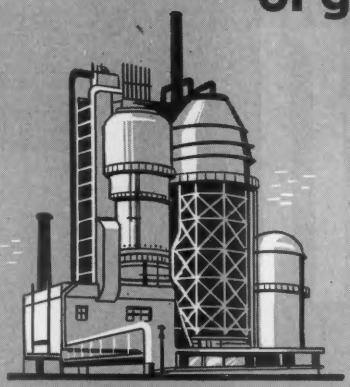

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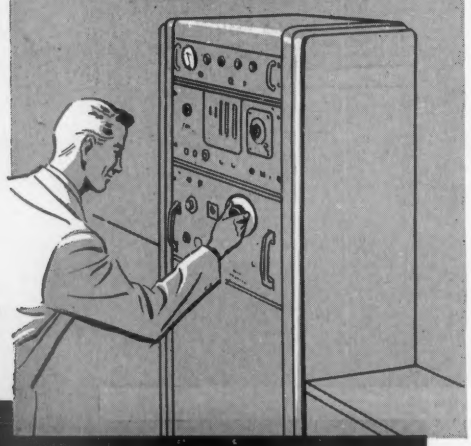

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Federation in Moderation

A Department of Science and Technology that would develop support for neglected areas of research but that would not disturb areas of research now being successfully pursued has been urged publicly on several occasions by Lloyd V. Berkner, president of Associated Universities, Inc. The scientific community, in general, has opposed a cabinet-level administration for science, in part because of the fear that the attempt to straighten out organization lines might seriously disrupt current scientific activities. By seeking ways of gaining leadership in scientific areas where other nations now surpass us, rather than stressing organizational elegance, Berkner attempts to meet this objection.

One aim of the proposed department—and it seems to us that in the long run this aim would prove to be the most important one—is to bring into focus government responsibility for developing certain new scientific areas of importance to the nation. The new areas would be those that employ expensive equipment, that require a coordinated effort by many people, and that do not fit readily into existing agencies. The 10-year program in oceanography recently proposed by a committee of the National Academy of Sciences–National Research Council might be developed by a division of the new department. Administrative arrangements for the new activities would be made, at least in part, through national laboratories—that is, laboratories supported but not operated by government agencies. Brookhaven National Laboratory, which is supported by the Atomic Energy Commission but operated by Associated Universities, Inc., might be taken as a model.

A second aim of the proposed move is to bring under central direction existing agencies that because of present organizational difficulties are not discharging their responsibilities with desirable vigor. Lack of full development of a field of research might occur because a bureau has no special relation to the task of the department in which it is located and thus finds it difficult to attract supporting funds. Development of a field of research might also be hampered because related scientific activities are divided among several departments. According to Berkner, the existing agencies that might with profit be brought into the proposed department include the Coast and Geodetic Survey, the Hydrographic Office, the Geological Survey, the Weather Bureau, and the National Bureau of Standards.

Although some present scientific agencies in the Government would be transferred to the proposed department, other agencies would not be disturbed. A research and development program that is closely related to the task of the department in which it is located would not be transferred. The Department of Defense, for example, would keep its Office of Defense Research and Engineering. And independent agencies that are of good size and of specialized function would not be transferred since they might deflect attention from the new activities that the proposed department is designed to develop. The National Aeronautics and Space Administration, for example, would retain its independence.

Although there may still be room for disagreement about the inclusion in the proposed department of this or that scientific activity, or even about creating a new department, many observers probably will laud the effort to devise a plan that by and large attempts to supplement rather than supplant present administrative arrangements. And observers who have opposed previous plans for a Department of Science and Technology probably will agree that new proposals should be considered on their own merits.—J.T.

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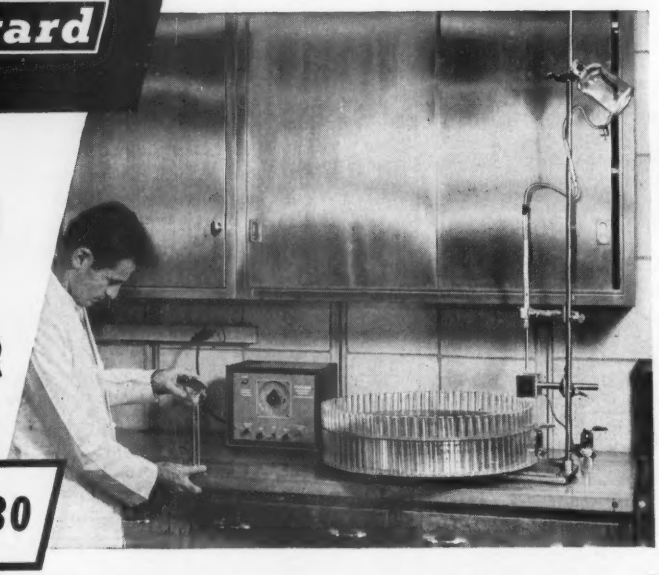

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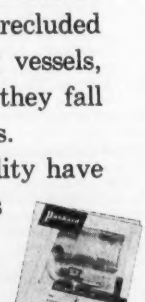

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CURRENT PROBLEMS IN RESEARCH

Antimetabolites

They help in discovery of metabolic pathways and in the understanding and treatment of some diseases.

D. W. Woolley

In recent years much study has been directed at the antimetabolites. These compounds have two distinguishing features: (i) they resemble in chemical structure some naturally occurring compound which is essential in living processes, and (ii) they specifically antagonize the biological action of such an essential compound. The vitally essential compounds have been called "essential metabolites" and are exemplified by the vitamins, the hormones, and certain other substances. The net result of the interference of the antimetabolite with the essential metabolite is to bring about a deficiency of the essential metabolite. The consequences of such a deficiency may be far-reaching for the organism and may bring about its death. These effects can, however, be beneficial, and it is this fact which has led to the use of the antimetabolites in attempts to treat disease.

The purpose of this article is to give some indication of what the antimetabolites are, and of the sort of thing that is being done with them, both in the elucidation of the mechanisms by means of which living things carry out their physiological reactions, and in the practical applications to the treatment of disease. This article is not intended to be a critical review of the field or an adequate summary of it. Several monographs are available, such as that of Woolley (*1*) or of Work and Work (*2*) if a more comprehensive discussion is desired. Only the bare elements can be mentioned here.

The author is with the Rockefeller Institute for Medical Research, New York.

Enzyme Function

To understand what an antimetabolite is, we must recall how an enzyme functions. An enzyme is believed to bring about the specific chemical reaction which it catalyzes by combining reversibly with its particular substrate. For many of the enzymes this specific substrate is one of the essential metabolites such as a vitamin, a purine, or an amino acid. The unstable enzyme-substrate complex which is thus formed undergoes some sort of molecular rearrangement or fission which yields the products derived from the substrate plus the enzyme. The cycle is then repeated because the enzyme has not been consumed in the process. The enzyme usually has two substrates instead of one, but this does not alter the mechanism now under discussion, since for the second substrate one conceives of the same basic process, but of a different combining site in the protein.

The specificity of the enzyme depends on its ability to combine with a given substrate, and not to combine with unrelated substances. The nature of the combining groups of the enzymes is one of the most fascinating puzzles of biochemistry. Some beginnings have been made in understanding the chemical structures of such combining groups of a few enzymes, but for none is it yet possible to write an adequate structure. It must be for each enzyme a configuration such as to form a reversible, dissociable union with a specific compound (the substrate) and not with many other substances.

In addition to its substrate, an enzyme usually will combine reversibly with a few structural relatives of the substrate. If the relative is of the same general structure (shape) and has some of the functional groups which are also present in the substrate, the fit is frequently good enough so that the analog will combine with the specific site in the enzyme. This is the first requisite of an antimetabolite. It must "look like" the substrate to the enzyme; in other words, the enzyme will combine with it in the same fashion as it does with the substrate. The structural analogy with the substrate is the important concern.

When the analog (the antimetabolite) has combined with the active site of the enzyme, this site is occupied so that the normal substrate cannot combine. The result is the exclusion of the substrate from its normal role and the creation of a deficiency of it. If the substrate is a vitamin or a hormone, a characteristic deficiency disease may thus be produced by the antimetabolite.

If the union between analog and enzyme is reversible, then an increase in the concentration of the substrate will allow the analog to be displaced. A deficiency disease induced by an antivitamin can thus be prevented or cured merely by an increase in the amount of vitamin in the food. The ratio between analog and essential metabolite which just allows the metabolite to displace the analog is different for each pair of compounds and each enzyme. What determines the ratio required is the relative combining affinities of substrate and analog for the enzyme. Almost always the enzyme prefers the substrate to the analog, so that much more antimetabolite than essential metabolite is required in order to produce a biological effect of the analog. However, it has been possible

to construct antimetabolites which the enzyme prefers to its normal substrate, and these are very potent compounds in biological test systems.

The second essential point about a compound which makes it an antimetabolite, then, is the ability to antagonize some of the biological effects of an essential metabolite. To call forth the characteristic signs of a deficiency disease is thus an important property of a compound if it is to be considered an antimetabolite. If, in addition, the biological effects can be reversed by the essential metabolite, the evidence is considerably strengthened. However, it is not necessary that a demonstration be made of the ability of a metabolite to reverse the effects of an antimetabolite, despite the fact that this is a point about which much argument has raged. Some have maintained that without the demonstration of reversibility a compound cannot be considered to be an antimetabolite. The plain fact is that one can construct an analog of some essential metabolite in such a way that it will be attracted specifically to the combining site of the enzyme and will react with this site irreversibly rather than reversibly. Once this has happened, no amount of extra essential metabolite will dislodge it. As might be expected, such irreversible analogs have frequently proved to be of high potency, since they have such an avidity for the enzyme. Some of the antimetabolites now used in the treatment of certain diseases are such irreversibly acting compounds. Aminopterin (Fig. 1), which is used with more or less success in the treatment of childhood leukemia, is such an example.

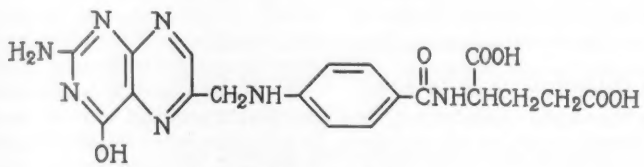
Conversion of Analogs

Sometimes the analog combines with the enzyme but, instead of stopping things at this stage, is actually converted into products analogous to those formed from the normal substrate. In other words, the enzyme uses the analog much as it does the natural substrate. The unnatural products formed may now act in the usual way to inhibit the next biological reaction in the physiological pathway. This has been shown to happen with certain analogs of purines and pyrimidines which go into the formation of nucleic acids.

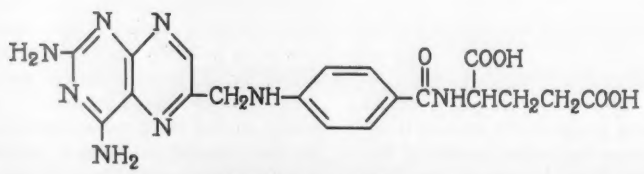
Thus, 8-azaguanine (Fig. 2), an analog of guanine, is incorporated into the nucleic acids of bacteria, viruses, and certain other forms of life. The nucleic acids of tobacco mosaic virus can thus be made to contain this unnatural substance. Some evidence suggests that this unnatural virus fails to function normally in the infection of the host plant, although this point is not entirely clear. Similarly, the pyrimidine thymine of the deoxynucleic acid of certain bacteria (*Escherichia coli*) can be partially replaced by the analogous 5-bromouracil (Fig. 3). The unnatural nucleic acid is then passed on for generations with each cell division, but the organisms so produced tend to form abnormal (pleomorphic) cell bodies, and to be at other disadvantages.

In like fashion, antimetabolites of some of the amino acids may be incorporated into proteins, as has been demonstrated with analogs of methionine and of phenylalanine. The analog *p*-fluorophenylalanine is thus incorporated into proteins of rabbits or microorganisms. One of these unnatural proteins has recently been isolated in crystalline form and shown to possess normal enzymatic activity (aldolase). In this case, therefore, the unnatural product formed from the analog functions in some respects as well as the natural one. It must be that some of the other unnatural products also formed do not function so well.

We must not think that these findings of incorporation of analogs mean that all antimetabolites function by being passed through the metabolic chain of reactions usually followed by the substrate. In many instances, no evidence for such incorporation has been found, despite concerted search. In other instances, such incorporation reactions are impossible because of the chemical structures of the analogs. Such, for example, is the case with malonate acting as an antimetabolite of succinate. The incorporation reactions are variations of the major theme of antimetabolite action. However, it is important to remember that they do occur, because it shows that an analog can often function in place of the real substrate. The specificity of enzymes is not as exquisite as is sometimes thought.



Folic acid



Aminopterin

Fig. 1. Structures of folic acid and aminopterin.

Sulfanilamide and Pyrithiamine as Antimetabolites

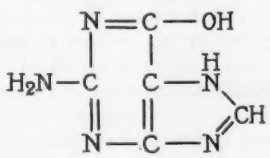
Two classical examples of antimetabolites can be used to illustrate the basic phenomenon. One of these is sulfanilamide as an antimetabolite of *p*-aminobenzoic acid, and the other is pyrithiamine as an antimetabolite of thiamine. Sulfanilamide, the structure of which is shown in Fig. 4, was developed rather empirically as a drug able to control some bacterial infections in man and other animals. Several years after its usefulness had been established, D. D. Woods in 1940 was studying why it inhibited bacterial growth and observed that its harmful effects on microorganisms could be overcome with small amounts of *p*-aminobenzoic acid. Woods was fully aware of the structural resemblance of sulfanilamide to *p*-aminobenzoic acid, and, in fact, had been led to test *p*-aminobenzoic acid because of the structural resemblance. He predicted that *p*-aminobenzoic acid would be found to be an important compound in the metabolism of bacteria, and this prediction was soon amply substantiated.

Not only did *p*-aminobenzoic acid

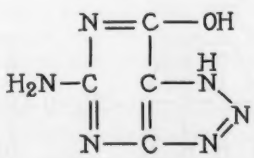
prove to be present in many living things in a combined form, but for some it was a dietary essential—that is, it was a vitamin. One of the combined forms into which it was built in living things also proved to be an important substance, namely, the vitamin known as folic acid (folacin or pteroylglutamic acid. See Fig. 1.) It has been demonstrated that in bacteria which are inhibited by sulfanilamide, the formation of folic acid and its derivatives is prevented. The enzyme system which makes this essential metabolite (folic acid) from *p*-aminobenzoic acid seems to be inhibited by sulfanilamide. For this enzyme system, *p*-aminobenzoic acid is the specific substrate, and this competes with the sulfanilamide for the enzyme system.

Sulfanilamide does not induce a deficiency of *p*-aminobenzoic acid in higher animals, in contrast to its action on some bacteria. The reason for this is not entirely understood, but seems to be related to the fact that the animals cannot synthesize folic acid, whereas the bacteria can. For the animals, then, folic acid is a vitamin which they must get from their food, but not for the bacteria which can make their own. It is the stoppage of this manufacturing of folic acid which is part of the mechanism of action of this drug. It is also intimately associated with the reason why the drug is selectively toxic and harms the bacteria without poisoning the host animal.

The original observation of Woods of the antagonism between sulfanilamide and *p*-aminobenzoic acid in bacterial

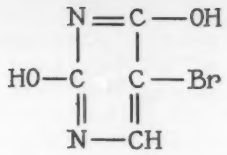


Guanine

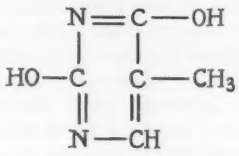


8-Azaguanine

Fig. 2. Structures of guanine and 8-azaguanine.



5-Bromouracil



Thymine

Fig. 3. Structures of 5-bromouracil and thymine.

growth was a landmark in the study of antimetabolites. There had been other prior observations of antagonisms between structurally related compounds, but they had not been widely heeded or understood. Because sulfanilamide was a popular, and, at that time, the best therapeutic agent for the control of several infectious diseases of man, the full impact of Woods' demonstration was heeded.

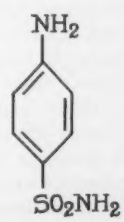
The second example, that of pyrithiamine as an antimetabolite of thiamine (vitamin B_1), is of interest because it was discovered through the use of higher animals. The characteristic signs of dietary lack of thiamine were well known in laboratory animals such as mice, chickens and pigeons, and were thus readily recognizable. This was different from the signs of a deficiency in bacterial cultures, because with the microorganisms one has principally the failure of growth to indicate disease, and failure of growth may be caused by many things. The induction of characteristic signs of a vitamin deficiency disease in animals thus indicates more clearly what one is dealing with.

In 1943 pyrithiamine was shown to induce the characteristic signs of thiamine deficiency in mice. The structures of antimetabolite and vitamin are shown in Fig. 5, where it can be seen that the relationship is close indeed. The deficiency disease caused by the eating of pyrithiamine could be cured or prevented by increasing the thiamine content of the food, so that the antagonism proved to be of the competitive kind. These same kinds of demonstrations were made with many kinds of microorganisms, as well as with higher animals. Thus, the addition of pyrithiamine to the culture media for several species of bacteria and fungi caused inhibition of growth, and this could be overcome merely by increased thiamine in the solutions.

It is not necessary to use living organisms or even organized tissues to observe the antagonism between metabolite and antimetabolite. The phenomenon can be studied in isolated enzyme systems, provided that the enzyme concerned can be separated from living tissue. This separation is not always possible, but in several cases where it has been acomplished the antagonism of the structurally related compounds has been shown.

A large number of antimetabolites are now known. The two examples just mentioned were selected principally for their historical importance, but many others could have been used. In fact, there are antimetabolites for each of the vitamins (except A and D), for several hormones, for most of the amino acids, purines, and pyrimidines, and for some of the other essential metabolites of living things. The methods of testing for the antagonistic actions of these compounds are also varied. The variation is as great as is the divergence in methods of assay for biologically active constituents of

p-Aminobenzoic acid



Sulfanilamide

Fig. 4. Structure of *p*-aminobenzoic acid and sulfanilamide.

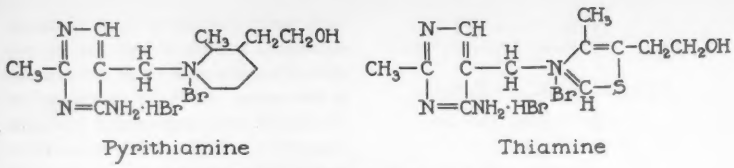


Fig. 5. Structures of pyrithiamine and thiamine.

living matter, because it is the interference in the assay procedure for a given metabolite which is usually used to demonstrate the activity of the antimetabolite.

Importance of Antimetabolites for Theory

The antimetabolites are of importance from a theoretical standpoint for several reasons. Through the use of a suitable antimetabolite, a specific deficiency can be created in a living organism. From the biochemical, anatomical, and functional changes which then arise, much information has been gained about the function of a given essential compound. Furthermore, when the changes induced in an animal in this fashion are seen to resemble the signs of a well-recognized but etiologically poorly understood disease, the cause of the disease may be suggested. This is a use of antimetabolites which is being much studied at the present time in the unraveling of the causation of certain mental diseases.

In addition, the demonstrations that some antimetabolites occur naturally, frequently in the same individual in which the metabolite also occurs and functions, has given considerable insight into the regulatory mechanisms at work in a living organism. Some of the "feedback mechanisms" by means of which cells check certain processes of synthesis, and thus prevent the useless accumulation of excessive amounts of their constituents, have been shown quite recently to be of this general kind. The finished molecule from a series of biochemical reactions frequently, because of its structural resemblance to one of the starting materials, is able to inhibit the enzyme which first directs this starting material through the metabolic pathway. These control mechanisms seem to offer a fertile field for future investigation along these lines.

The natural ocurrence of certain antimetabolites also has indicated the nature of some diseases. Thus, for example, a disease of tobacco plants, the so-called wildfire disease, which is the result of infection of the plant by a pathogenic bacterium (*Pseudomonas tabaci*), is caused by a toxin which this invader liberates. The toxin has been isolated in pure condition and shown to be an antimetabolite of methionine. The disease thus seems to be the expression of a methionine deficiency produced in the host by the invading pathogen.

Finally, the existence of antagonism between structurally related compounds is having a considerable influence on the course of thinking about the active sites of enzymes and hormonal receptors. People are beginning to explore the idea that these may have a structural resemblance to the specific essential metabolites with which they combine. This idea is motivating much of the research in this important and fascinating subject at the present time. The attraction (perhaps due to Van der Waal's forces) which exists between like groups of atoms may be the binding force which confers the specificity and provides the force of union in these cases. Let us then discuss briefly a few examples (in addition to those just indicated) of these uses of antimetabolites in theoretical science.

The original clues about the reactions by means of which purines are synthesized by living organisms came from the use of antimetabolites. When bacteria such as *Escherichia coli* are grown in an amount of sulfanilamide just sufficient to cause slight inhibition of growth, they form a new compound, which was isolated and characterized as 4-amino-5-carboxamidoimidazole. (See Fig. 6). Sulfanilamide inhibits the synthesis of folic acid from *p*-aminobenzoic acid, and there was evidence to suggest that folic acid participated in the biosynthesis of the purines. It was therefore not surprising to find that an antimetabolite of folic acid also caused accumulation of this imidazole. All that is required to convert the imidazole to the purine hypoxanthine is the insertion of a carbon atom by means of a reaction with formic acid. It thus became plain that the pathway

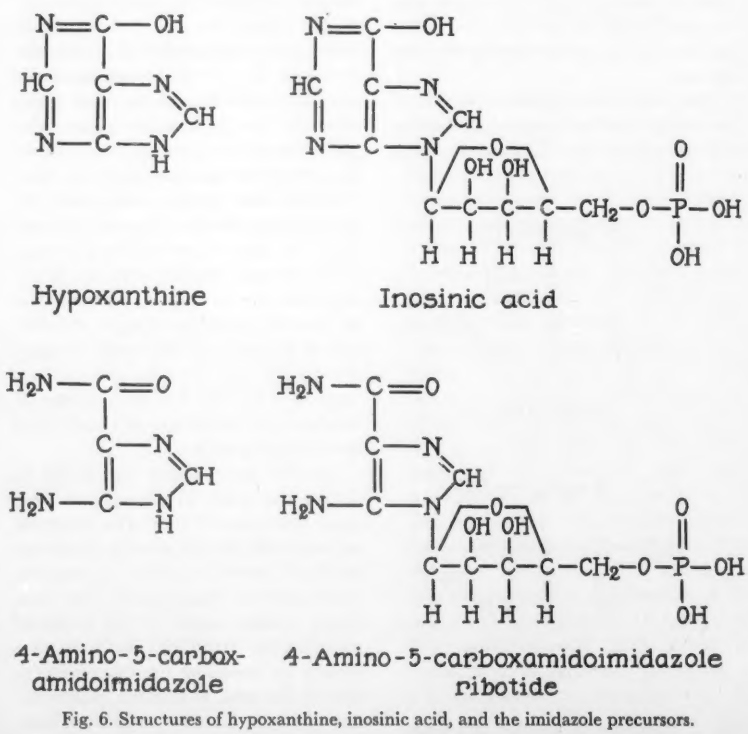


Fig. 6. Structures of hypoxanthine, inosinic acid, and the imidazole precursors.

of purine biosynthesis was to the formation of the imidazole derivative followed by insertion of a formyl group to yield the purine ring.

Prior to this work with sulfanilamide, the existence of such a pathway, or even of the imidazole derivative, in living things had not been indicated. More detailed investigation of these reactions with radioisotopes and by classical enzymology has shown that the ribotide of the imidazole is the real precursor, and that inosinic acid (hypoxanthine ribotide), rather than hypoxanthine itself, is the product. Other purines can be derived from inosinic acid by suitable enzymic steps. It is not without interest that the participants in some of these additional steps were also detected partly through the use of antimetabolites of them. The understanding of the biosynthesis of this group of biologically very important compounds was thus discovered to a considerable degree by the use of suitable antimetabolites.

Serotonin

The use of antimetabolites to elucidate the cause of noninfectious diseases could be illustrated by any one of several examples, but the one having to do with schizophrenia will serve to show the way it is done. Serotonin is a recently discovered hormone which causes smooth muscles to contract. Its chemical structure is shown in Fig. 7. It is an essential metabolite which is found in certain tissues such as the argentaffin cells of the stomach and intestines, in the platelets of the blood, in certain portions of the brain, and in some ganglia of the peripheral nervous system.

Antimetabolites of serotonin were synthesized recently with the idea in mind that these, when given to animals, would induce specifically a deficiency of serotonin, and that the changes thus incited might reveal some of the purposes for which an animal has this hormone.

There was also a practical reason for making these antimetabolites, which will be discussed presently. Some of these antiserotonins were found to call forth in animals and in men a kind of behavior similar to that seen in mentally deranged individuals. Certain other neurological disturbances were also called forth by some of these compounds. Thus, the nitroindole analog shown in Fig. 7 brought about a change in character of mice and induced deep mental depression in human beings. The analog medmain shown in Fig. 7 incited convulsions in mice which were reminiscent of the seizures of *grand mal* epilepsy in man. Such findings suggested strongly that serotonin had a role to play in the central nervous system which was associated with the maintenance of normal mental equilibrium and normal behavior.

While this work on the synthetic analogs of serotonin was in progress, it was shown that several classes of drugs which had been long known and traditionally obtained from plants were in fact structural analogs of serotonin and were capable of antagonizing the actions of this hormone in a reversible fashion on smooth muscles. It was thus clear that these drugs were naturally occurring antimetabolites of serotonin. Harmine and its relatives, yohimbine and its relatives, and the ergot alkaloids were the drugs so studied (Fig. 7). It was further noted that at least one member of each of these series of drugs was well known to induce in normal men a temporary condition resembling schizophrenia, with its visual hallucinations and changes in personality.

This ability of naturally occurring as well as of synthetic antimetabolites of serotonin to induce some of the signs of the mental diseases led Woolley and Shaw in 1954 to suggest that the natural disease commonly called schizophrenia was the reflection of a disturbance in the functioning of serotonin in the brain. This suggestion has been much debated recently, but it can be said that a considerable body of supporting evidence has been produced. One such piece of evidence which has received much attention is the finding that a drug which clearly affects the mind, namely, the tranquilizer known as reserpine, is a structural analog of serotonin, being a derivative of yohimbine. It behaves in some respects as an antimetabolite of this hormone.

Just as with the early finding of the antagonism between sulfanilamide and *p*-aminobenzoic acid, the fact that reserpine (like sulfanilamide) was a drug being widely used in the clinical treatment of a disease counted for more in men's minds than did prior demonstrations of the same fact with chemical compounds which were not being used as fashionable drugs. In the serotonin case, in contrast to the situation with sulfanilamide, the ideas and evidence had been clearly enunciated before the demonstrations with the practical drug. And yet the findings with the practical drug were the ones which seemed to carry more weight in most minds.

The evidence for the participation of serotonin in mental disorders is not yet complete. Work in this direction is going on actively at the present time. If it should prove possible to control adequately the disease as a result of the suggestion that serotonin plays a role in it, then we must say that the causation of this disease, or at least an etiological agent in it, was discovered through the use of antimetabolites.

The work which showed that several kinds of well-known drugs of plant origin were acting on animals as antimetabolites of serotonin, as outlined above,

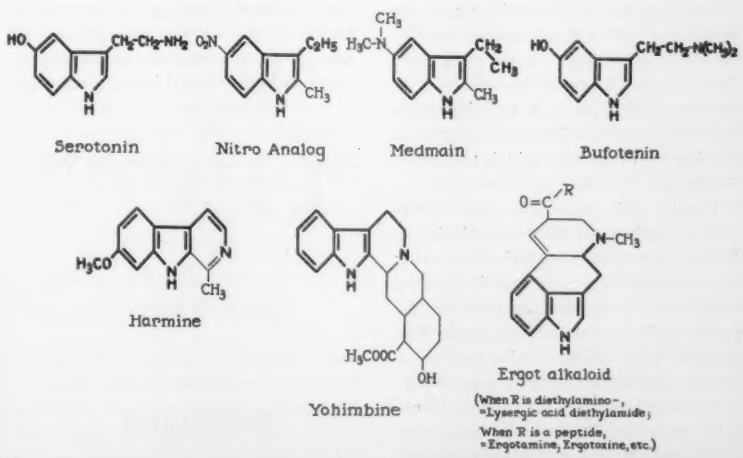


Fig. 7. Structures of serotonin and some psychosis-inducing antimetabolites of it.

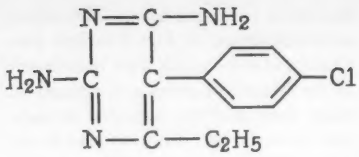
points to another use of the antimetabolite concept. The mechanism of action of these plant alkaloids, or at least a part of that mechanism, was made clear by these studies. These alkaloids act by creating a deficiency of the hormone serotonin in certain tissues. It must also be added that on some tissues some of these compounds act like serotonin, instead of being antagonistic to it. In these tissues the analog seems to fit the serotonin receptors well enough to function in its stead. I have shown earlier in this article how an analog may be near enough in structure to the essential metabolite to act as a substitute for that metabolite in some reactions.

Antimetabolites and Chemotherapy

In addition to the uses of antimetabolites in solving questions of theory, uses of a practical kind have been envisioned, and some have been found. These are the uses in chemotherapy of infectious and noninfectious diseases. After the demonstration of the antagonism between sulfanilamide and *p*-aminobenzoic acid there was a wave of enthusiasm, because it was held that the control of infectious diseases by rational rather than chance means was just around the corner. All that would be required would be to make a suitable antimetabolite of some bacterial growth factor.

This proved to be an oversimplification. No attention was paid to the question of how to make drugs of this sort which would not poison the host animal as well as the parasite. No attention was paid to many other important considerations. This, and the fact that the empirical approach through the search for antibiotics paid off so well in the discovery of new drugs for the control of infections, made many turn away from the antimetabolites as a practical solution. This was especially so among those looking for drugs with which to control infections.

Despite this, however, some noteworthy results were achieved, principally in the suppression of malaria. Two kinds of antimetabolites were found effective, firstly, some of the antipantothenic acids, and secondly, certain antifolic acids. The antifolic acids are now being used on a rather considerable scale in some equatorial countries. For this purpose, daraprim, shown in Fig. 8, is the compound most used. It is not a close structural analog of folic acid but appears to be more closely related to thymine, a pyrimidine which is formed in living things through the participation of folic acid. Nevertheless, existing evidence seems to suggest that daraprim is more of an antifolic acid than an antithymine.



Daraprim

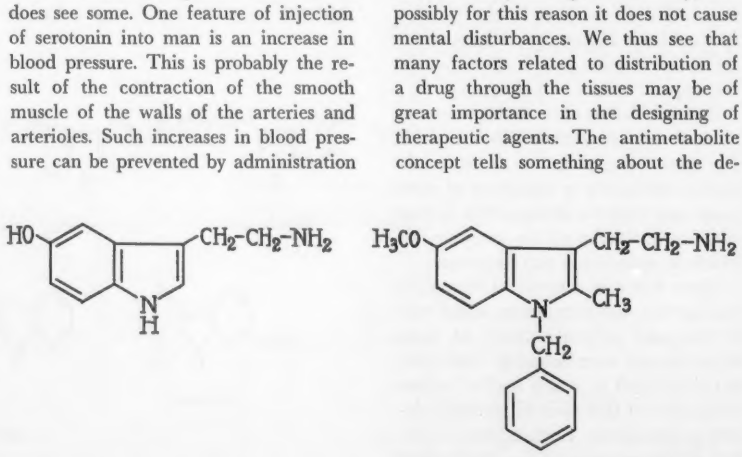
Fig. 8. Structure of daraprim.

Among investigators dealing with noninfectious diseases, the antimetabolite concept has been somewhat more popular as a means to the discovery of therapeutic agents. Among those attempting to control cancers, this has been particularly true, but among students of endocrine disorders there are also those who have had some success in its application.

A few of the concepts should concern us here. If a disease arises, as some do, from an excessive amount of a given hormone in the body, it should be possible to control this disorder by administration of a suitable antimetabolite of the hormone. For example, suppose that an excess of serotonin were to arise in the body, either as the result of too great a production or too slow destruction of it. One can measure some of the effects of such an excess merely by injection of some of the hormone. One does not thus see all of the possible effects, but does see some. One feature of injection of serotonin into man is an increase in blood pressure. This is probably the result of the contraction of the smooth muscle of the walls of the arteries and arterioles. Such increases in blood pressure can be prevented by administration of a suitable antimetabolite of serotonin. If, then, some of the cases of human hypertension are related to an excess of serotonin in the body, such an antimetabolite would be expected to bring about a reduction in blood pressure in the disease. It is by no means established that some cases of human hypertension do result from an excess of serotonin, but the reduction of pressure in such patients would be evidence to suggest it as an etiological agent. Especially would this be true if it were found that the antimetabolite did not reduce blood pressure in normal human beings.

The antimetabolite of serotonin shown in Fig. 9 was synthesized and tested in human hypertension with the idea in mind that the disease in some individuals might be the expression of an excess of serotonin. The compound was found not to reduce the blood pressures of normal animals and men, but did bring about such reduction, and other beneficial effects, in a considerable number of people suffering from high blood pressure.

Because of the ability of certain antimetabolites of serotonin to induce mental changes, one may wonder how it was possible to use this antimetabolite safely. The drug was found not to induce the mental changes which are called forth by many other antiserotonins. This resulted, not simply from a lucky chance, but because, in fact, the drug was designed with the intent of keeping it out of the central nervous system. In so far as has been determined, it passes into the brain only with great difficulty, and possibly for this reason it does not cause mental disturbances. We thus see that many factors related to distribution of a drug through the tissues may be of great importance in the designing of therapeutic agents. The antimetabolite concept tells something about the de-



Serotonin

1-Benzyl-2,5-dimethyl-serotonin
Benzyl analog of serotonin (BAS)

Fig. 9. Structure of serotonin and a benzyl analog of serotonin.

signing of drugs but it does not tell all.

There seem to be many disorders which arise from excesses of this or that hormone. The possibility of controling some of these in the manner indicated seems enticing. Especially is this so when it begins to become clear that several drugs which have been discovered and used empirically for the control of certain disorders are in fact antimetabolites of some hormone or other essential metabolite.

The practical applications of the antimetabolites to attempts at chemotherapy could have been illustrated equally well with a variety of other drugs which have been introduced recently. None of these is completely satisfactory from a practical standpoint, and there are still those who maintain that it is unlikely that this record can be improved. The examples chosen were selected because they are well known to me and because they indictate the status of the field as it exists today.

References

1. D. W. Woolley, *A Study of Antimetabolites* (Wiley, New York, 1952).
2. T. S. Work and E. Work, *The Basis of Chemotherapy* (Oliver and Boyd, Edinburgh, Scotland, 1948).

CURRENT PROBLEMS IN RESEARCH

New Research on Old Gravitation

Are the observed physical constants independent of the position, epoch, and velocity of the laboratory?

R. H. Dicke

While fully aware of the hazards, both natural and occult, incident to the discussion of experiments not yet completed, I welcome the opportunity to say something about our research on gravitation, particularly about its motivation, for there appears to be considerable misunderstanding of the state of knowledge of this important force field.

With the exception of a few isolated experiments, there has been essentially no basic experimental research on gravitation in the past 30 years. There are several reasons for this. First, because of the weakness of the gravitational field, such experiments are invariably difficult, and many of the most important are impossible. Second, because of the successes as well as the basic simplicity and elegance of Einstein's relativistic theory of gravitation, the feeling has been widespread that this theory must be correct. Third, it has been generally believed by physicists that the gravitational interaction is too weak to be important for modern physics.

Needless to say, my coworkers and I do not agree with this diagnosis. First, new experimental techniques now make possible experiments formerly impossible. Second, while Einstein's theory is admittedly elegant, we are not sure that nature has quite the predilection for an elegant theory that man apparently possesses. Third, although gravitation is weak, it may play a crucial role in the structure of a particle. If, as is believed by many physicists, an elementary particle is a complex structure of very small size consisting of a core particle surrounded by a swarm of attendant virtual particles, the gravitational interaction may be one of the dominant forces acting on very-high-momentum particles found at the core. It has been suggested that it is the failure to take into account such interactions which is the root of the difficulty leading to divergences in quantum-field theories.

The author is a member of the staff of the Palmer Physical Laboratory, Princeton University, Princeton, N.J.

Observational Evidence for Theory of General Relativity

The experimental and observational support for Einstein's theory of general relativity consists primarily of facts available before the construction of the theory. These consist of the large body of data on planetary motion, including the anomalous rotation of the perihelion of Mercury's orbit. There is also the accurate experiment of Eötvös (*1*) and others on the equivalence of inertial and gravitational mass. The only observational facts found subsequently are the gravitational deflection of light by the sun and the gravitational red shift. Because of the smallness of these effects, both of these checks of the theory of general relativity are inaccurate. The astronomical observations of planetary orbits are very accurate; however, a comparison between the observed orbits and calculated orbits always shows small systematic discrepancies (*2*). The discrepancies are believed to be due primarily to computational errors and systematic errors in observation. While this may be true, there is always the possibility that some of the systematic error may be of a more fundamental character. It should also be remembered that the velocities of the planets are so low that gravitational retardation effects are essentially unobservable.

Conceptual Difficulties

In addition to dissatisfaction with the scanty observational evidence supporting Einstein's theory of gravitation, there are certain conceptual difficulties which are a source of doubt concerning the complete correctness of the theory in its present form. These difficulties are associated with the problem of inertial coordinate systems and the existence of inertial forces.

In the mechanics formulated by Newton in the 17th century it was assumed that there existed an absolute physical space which could be characterized by a Euclidean geometry. An acceleration of a particle with respect to this space required a force. Equivalently, in the accelerated coordinate frame for which this particle was at rest, there appeared an inertial force acting upon the particle.

This situation long appeared enigmatic, and some of the difficulties were

discussed as early as 1710 by Bishop Berkeley (*3*). Among the difficulties are the following. There is a basic difference between the conceptual space of the mathematician and the physical space of the physicist. A mathematician merely needs to assume the existence of a set of points having certain properties to define a space. A physicist must consider the physical significance of such mathematical concepts as points, lines, and geodesics. If the physical space in question is a vacuum, assumed to be a void—that is, structureless—it is not clear what is the physical significance of points in such a space or the meaning of either velocity or acceleration with respect to such a space. It is also not clear how such a space is to be parameterized—the first step in the construction of a geometry.

Mach's Principle

In 1872, E. Mach (*4*) made a notable suggestion: he surmised that the inertial force did not arise from motion relative to space but had its origin in the acceleration of a particle relative to distant matter. Equivalently, in the coordinate system with the particle at rest, it was the acceleration of distant matter which was to be regarded as the source of the inertial force acting on the particle.

Mach apparently had in mind a type of instantaneous action at a distance as the means by which very distant matter would produce this force. It would be more in keeping with modern notions of the nature of forces if the inertial force could be some day traced to a purely local interaction with the particles of a quantized field. This field would be assumed to have its source in all the matter of the universe. As was emphasized by Sciama (*5*), there is every reason for assuming that this inertial field is not some new type of field but merely the gravitational field of distant matter. A particle at rest at the origin of a coordinate system in which distant galaxies are streaming uniformly and isotropically away from the origin would feel no force, by reason of symmetry. However, an acceleration destroys this symmetry, and it would be expected that this distant accelerated matter would be a source of a gravitational field. Kaempffer (*6*) has also discussed this question. Earlier Einstein (*7*) and Davidson (*8*) discussed Mach's principle from the point of view of the theory of general relativity.

Einstein made substantial progress in devising a system of mechanics in accord with Mach's principle. First, in connection with his contributions to the special theory of relativity, he early emphasized that it is only the motion of matter relative to other matter which is physically significant. However, this theory considered only uniformly moving—that is, inertial—coordinate systems and failed to come to grips with the central problem, the relation of inertial coordinates to the matter distribution of the universe.

Because of the way in which Einstein's general theory of relativity arose as a generalization of the special theory, it also failed to attack squarely the problem of the origin of inertial forces. This is evident, for example, in the fact that Einstein's field equations have solutions usually regarded as meaningful even in the absence of all matter. It has not yet been found possible to systematically eliminate such solutions. On the other hand, it was early recognized by Einstein (*7*) and Thirring (*9*) that at least some of Mach's program had been realized in the theory of general relativity. Thus, for example, it was shown by Thirring (*9*) that a hollow rotating massive sphere tended to drag the inertial coordinate system around with it.

It early appeared that only solutions of Einstein's equations for which there was some definite total amount of matter at great distances could be reasonably said to be in accord with Mach's principle. The root of the difficulty is easily illustrated by an example due to Sciama (*5*). Consider a universe empty except for a hollow-mass sphere containing near its center two particles attracting each other gravitationally. In a coordinate system with one of these particles at rest, the gravitational pull of the other particle is assumed to be balanced by the gravitational pull having its origin in the accelerated massive shell. It would be expected that the more massive this spherical shell, the greater the inertial force, and that only for a particular mass for this shell would the correct inertial force be obtained. The simple dimensional arguments given below are sufficient to obtain the required relation.

It would be expected from Newton's second law that the inertial force would be proportional to the mass and acceleration of the particle experiencing the force. It would also be reasonable to expect it to be proportional to the mass of the hollow sphere. The force should also depend upon the radius of the sphere, the gravitational constant, and the velocity of light. A not unreasonable expression for the inertial force is, therefore,

$$F = bmMaG^{\alpha}r^{\beta}c^{\gamma} \qquad (1)$$

with m the mass of the particle, M the mass of the spherical shell, a the acceleration of the sphere relative to the mass particle, and r the radius of the sphere; b is a dimensionless constant which would be expected to be of the order of unity, and α, β, and γ are other constants. The only possibility for the constants α, β, and γ which is compatible with dimensions on both sides of the equation is

$$\alpha = 1, \beta = -1, \gamma = -2$$

which, since Newton's second law

$$F = ma \qquad (2)$$

must be satisfied, implies that

$$GM/rc^2 \simeq 1 \qquad (3)$$

Considerable support for this interpretation of Mach's principle is obtained when it is noted that the actual mass density of the universe is such that Eq. 3 is approximately satisfied with M and r interpreted as the mass and radius of the visible part of the universe. It should be pointed out, however, that the actual mass density of the universe is but poorly known. Because of the expansion of the universe, if it is assumed that gravitation propagates with the velocity of light, it would be expected that the effect of distant masses would become vanishingly small at the radius of the visible universe and that masses lying outside this radius would be without effect.

What interpretation is to be made of Eq. 3? Einstein (*7*) and more recently Davidson (*8*) consider this to imply that only certain universes are possible. Thus, Davidson has pointed out that a condition of the type of Eq. 3 is satisfied for an expanding universe which is flat, and that the continuous-creation universe requires this type of cosmology. He, therefore, considers this to be an argument for a continuous-creation cosmology.

There are, however, certain difficulties in assuming that Mach's principle imposes a structural condition upon the universe. The gravitational force is very weak, and one could imagine universes whose structures are determined not by gravitation but by the enormously stronger electrical forces. To give a trivial example, a spherical shell in the form of a monomolecular layer of hydrogen would require roughly 10^{80} atoms if Eq. 3 were to be satisfied. If the same 10^{80} atoms were arranged in a double-layered

shell, Eq. 3 would not be satisfied for the same values of G and c. Of course, the universe cannot be tinkered with in quite so drastic a fashion, but it should be possible to take some of the matter at great distance and bring it in closer to change the effective value of M/r. For example, a physicist might build a massive concrete shell around his laboratory. It might be expected that this would change the effective ratio of M to r in Eq. 3. With this interpretation, either Mach's principle is not satisfied or one or the other, or both, of the constants G and c in Eq. 3 are not constant. There is considerable evidence for at least the approximate constancy of c, and consequently it is G which would be expected to vary.

Gravitational Constant as a Field Variable

While the above argument is admittedly highly conjectural, it raises interesting questions. If this interpretation of the gravitational constant as a field variable is correct, there are three important ways in which observable changes in G may occur: (i) through the expansion of the universe; (ii) through the effect of nearby matter, and (iii) by motion relative to distant matter.

A time-varying gravitational constant resulting from the expansion of the universe would have far-reaching geophysical and astrophysical consequences. Some of these have been previously discussed (*10*). The possible effect on the gravitational constant of nearby matter is less startling. Thus, the effect of the sun's mass on the gravitational constant at the earth would result in a decrease of G of very roughly 1 part in 10^8.

Many years ago Dirac proposed that from the sizes of a number of important physical and astrophysical constants one might conclude that the gravitational constant is varying inversely as the age of the universe. It is therefore interesting to note that the condition of Eq. 3 results from Dirac's argument. With the Dirac cosmology, the radius of the visible universe expands more rapidly than matter at that radius. This sweeps more and more matter into the visible region, causing M/r to increase proportionally to the time. Eq. 3 continues to be satisfied as G varies inversely as the time.

If the gravitational constant is really a variable, what about other atomic constants? On the basis of the sizes of dimensionless representations of these constants it would appear that if such numbers as, for example, the fine-structure constant

$$\alpha = e^2/\hbar c$$

were to vary with time, its variation would very likely be slow. Landau has suggested, from considerations of renormalized field theories, that the fine-structure constant may be approximately the reciprocal of

$$\log_e (\hbar c/Gm^2)$$

with m the mass of the electron. If so, its variation would be only logarithmic in time, if it is assumed that G varies inversely with the time.

In addition to the gravitational constant, the only atomic constant which could be reasonably expected to vary strongly with time is the weak-coupling constant. The weak-coupling constant determines the rate of decay of the π- and μ-mesons as well as β decay of radioactive nuclei. As a result, with the assumption of a time variation of the β-decay rate, discrepancies between α- and β-decay ages for old rocks and meteorites could appear (*11*).

Principle of Equivalence

The problem of the constancy of the atomic constants is directly related to the fundamental postulates of the theory of general relativity. The principle of equivalence, as used by Einstein in formulating his theory, assumes that, except for the effects of inhomogeneities in the gravitational field, the laws of physics observed in a freely falling laboratory are independent of time and place. This interpretation of the equivalence principle has been called the "strong principle of equivalence." On the other hand, there is a weak form of the principle which assumes that the gravitational acceleration of a body is independent of its structure. The very accurate Eötvös experiment constitutes strong support for the validity

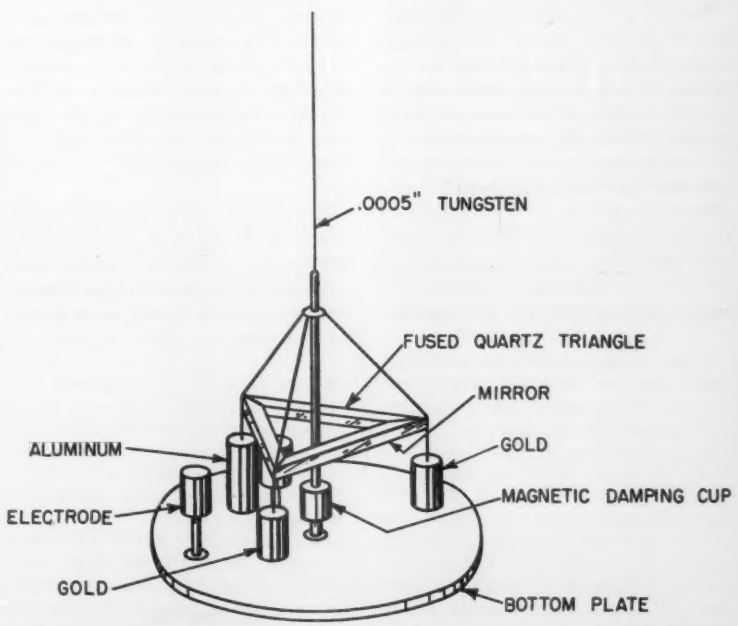


Fig. 1. Apparatus for investigating the equivalence of inertial and passive gravitational mass. With the sun on the horizon in a direction defined by a line through the two gold weights, the earth and laboratory are accelerated toward the sun. Inertial forces pull backward on all three weights; gravitational forces produced by the sun pull forward. If there should be an inequality in these forces for gold compared with aluminum, a torque would result, twisting the fine wire. The rotation is detected automatically by means of light reflected from the mirror to a photocell. The detection system is capable of seeing a rotation of 10^{-8} radians. Voltages proportional to the rotation are applied to the electrodes to decrease the response time of the instrument and to damp oscillations. To the present accuracy of the observations ($\sim 3 \times 10^{-10}$), no positive effect has been observed. The inertial and passive gravitational masses are equivalent.

of the weak form of the principle but not necessarily for the strong version. The strong principle implies the constancy of the atomic constants. Also, as was pointed out by Sciama (*5*), Mach's principle seems to require the validity of the weak form of the equivalence principle. Thus it appears that there is good direct experimental support for the weak form of the principle but not necessarily for the strong form.

The above extended discussion has served to illustrate the basis for our suspicion that the usual interpretation of Einstein's theory of gravitation may not be completely correct. It is only the weak form of the equivalence principle which has a sound experimental basis. For this reason we feel that it is important to use the greatly improved modern experimental techniques to investigate the fundamental facts about gravitation, in particular to test the strong principle of equivalence.

Improved Experimental Techniques

Because of the very important position of the weak version of the equivalence principle, it was decided, first, to attempt to improve the classic Eötvös experiment. Two experiments are being set up, and one has already yielded a preliminary measurement which seems to represent an order-of-magnitude improvement over Eötvös' (*1*) experiment. In this experiment (Fig. 1) a torsion balance employing a torsion pendulum in the form of a horizontal equilateral triangle is supported from a fine tungsten wire. Equal masses are supported from each of the three corners. Two are gold and one is aluminum. An acceleration of the earth and apparatus toward the sun causes inertial forces to act on the three masses. If these were not closely balanced by the gravitational forces, a torque would result which would twist the fine wire. This torque should then vary in the proper way with the sun's position. No such effect was observed. A variation of this experiment in which an oscillating pendulum is employed is being set up by one of our group, Sidney Liebes.

Two of the members of the group, William Hoffmann and James Faller, are designing gravimeters which, it is hoped, will be capable of long-term stability. By measuring the earth's gravitational acceleration we hope to be able to say something about possible annual variations in the gravitational constant due to a velocity-dependence of the gravitational interaction.

A member of the group, Carroll Alley, is constructing a very precise atomic clock employing rubidium vapor. This will be compared with a similar clock employing a beam of cesium atoms. As the atoms of the cesium clock are moving in a definite direction, motional effects on the fine-structure constant and/or other constants may show up as a daily variation in a discordance between the two clocks (*12*).

The group is also greatly interested in atomic clocks per se. A most important experiment is a comparison of an atomic measure of time with a good gravitational measure in order to look for a secular variation which could be attributed to a secular variation in the gravitational constant. Also an annual variation in the two time rates could support the suspicion that there may be a velocity-dependence of the locally observed gravitational constant. In this connection it has been suggested that a satellite be used to give an improved measure of gravitational time.

It is hoped that the application of improved experimental techniques can give increased information about the spectra of atoms on the sun and hence about the gravitational red shift and the value of the fine-structure constant on the sun as compared with the earth. An experiment of this type is presently being planned.

Some preliminary design work has also been done on an experiment to attempt to improve the accuracy of the information on the gravitational deflection of light (*13*).

References and Notes

1. R. V. Eötvös, *Ann. Physik* 68, 11 (1922).
2. G. M. Clemence, *Monthly Notices Roy. Astron. Soc.* 111, 219 (1951).
3. G. Berkeley, *A Treatise concerning the Principles of Human Knowledge* (1710).
4. E. Mach, *Conservation of Energy* (1872); *Science of Mechanics* (ed. 6, 1904).
5. D. W. Sciama, *Monthly Notices Roy. Astron. Soc.* 113, 34 (1953).
6. F. A. Kampffer, *Can. J. Phys.* 36, 151 (1958).
7. A. Einstein, *The Meaning of Relativity* (Methuen, London, ed. 5, 1951).
8. W. Davidson, *Monthly Notices Roy. Astron. Soc.* 117, 212 (1957).
9. H. Thirring, *Physik. Z.* 19, 33 (1918).
10. R. H. Dicke, *Revs. Modern Phys.* 29, 355 (1957).
11. R. H. Dicke, *Nature*, in press.
12. *Note added in proof*: Preliminary results on a similar experiment have been reported by J. P. Cedarholm, G. F. Bland, B. L. Havens, and C. H. Townes [*Phys. Rev. Letters* 1, 342 (1958)].

13. This study was supported by the U.S. Atomic Energy Commission, the Office of Naval Research, and the Higgins Scientific Trust Fund.

News of Science

Loyalty Provisions of National Defense Education Act Meet Opposition from Educators and Congressmen

The opposition to the loyalty provisions in the National Defense Education Act has led to a swelling tide of formal protests by individual scholars, their institutions, and their professional organizations. Section 1001 (f), Title X, of the act requires the recipients of scholarships and fellowship funds to execute two oaths: (i) a disclaimer affidavit that the recipient does not "believe in, is not a member of, and does not support any organization that believes in or teaches the overthrow of the United States Government by force or violence or by any illegal or unconstitutional methods"; and (ii) the oath of allegiance to support the Constitution.

These provisions received scant attention when they were inserted in the act by Senator Karl E. Mundt (R-S.D.) during the hurried closing days of the 85th Congress. Now they are the basis for repeal action in five bills before the House and one before the Senate. On 12 February Senator Mundt indicated through one of his aides that he would not oppose revision of his amendment.

In general, most academic people are not too concerned about the inclusion in the act of the traditional oath of allegiance, although they would like to see it dropped because they consider it at best unnecessary and absurd. But they view the disclaimer affidavit as potentially dangerous. One of the first warning notes about its implications was sounded by the American Council on Education in a report on the Education Act in the 28 August issue of *Higher Education and National Affairs*. It said: "The stale aroma of McCarthyism envelops one general provision of the bill, SEC. 1001 (f)."

Implications of the Loyalty Provisions

Shortly thereafter the American Association of University Professors, which has nearly 600 chapters in colleges and universities throughout the country, began to plan action to combat the measure. On 1 November the officers of the 40,000-member organization sent a letter of protest to members of the Senate Labor and Public Welfare Committee and the House Education and Labor Committee. The letter, signed by Bentley Glass, president, and William P. Fidler, general secretary, described the following specific objections to Section 1001 (f):

"A person required to execute a disclaimer statement is given no guidance as to the organizations which are of the designated variety, and no definition of the support to such organizations which he must disclaim. We submit that it is a denial of due process of law to compel an individual to gauge his conduct by such vague criteria, when criminal liability may turn on his action. . . .

"There is ground for grave question concerning the validity of requiring a disclaimer of the sort specified in the Act, as a condition of enjoying governmental benefits. . . . Moreover, the provision here in question is not in terms limited to 'knowing' support of the specified type of organization. . . .

"It is difficult to leave unquestioned legislation which borders so closely on unconstitutionality in a First Amendment area, and which may well overstep the line. . . .

"A disclaimer requirement or test oath by its nature cannot fail to be invidious. If an individual refuses to sign, he raises a suspicion that he is unworthy of public trust or benefit. If he signs, he endorses the pertinency of the general suspicion about him and his kind which is embodied in the requirement. Social safeguards should be directed to specific dangers; they should not, as in this instance, take the form of inescapable and unwarranted derogatory implications directed toward a whole class of persons and all its members. . . .

"The Act seems to say to members of the educational community: 'You are an important part of American life and you have an admitted real need, but let there be no mistake about the fact that you are a particularly suspect part of the population and will have to pass a special test that other citizens need not take.' This is a prejudgment of the teachers and students of America which we cannot believe the Congress intended to make."

An early published comment on the possible harmful effects of the controversial subsection was presented in an editorial entitled "Big Brother Again" that appeared in the 14 November issue of *Science*.

University Presidents Protest

Since then the public outcry from educators has grown steadily, so that it has now assumed impressive proportions. Secretary of Health, Education, and Welfare Arthur S. Flemming, former president of Ohio Wesleyan University, told a press conference in December that he felt that the loyalty subsection would do little or no good, that subversives would "have no scruples about signing such an affidavit and taking such an oath." He also pointed out that administering the measure would require Government expenditure that would not contribute to the national security.

Three days later, on 19 December, the president of Yale University, A. Whitney Griswold, sent a letter to Flemming urging repeal of the section and saying that "oaths and affidavits of this sort are especially distasteful when they are required of young people who are just entering upon the most important phase of their educational experience" and that such provisions "are at best odious, at worst a potential threat to our profession."

Subsequently, three other university presidents wrote to Flemming to endorse Griswold's comments: Nathan H. Pusey of Harvard, Robert F. Goheen of Princeton, and Gaylord P. Harnwell of Pennsylvania.

In January and February nine more presidents offered public protests; however, these asked solely for the elimination of the disclaimer affidavit. The members of this group represented Bryn Mawr, Haverford, and Swarthmore (all in Pennsylvania); Bates, Bowdoin, and Colby (all in Maine); Reed (in Oregon); the University of Rhode Island; and American University (in the District of Columbia). The *New York Times* reported that Conrad A. Elvehjem, president of the University of Wisconsin, had also objected.

So far, five institutions have gone a step further than public statements and have refused to accept educational aid funds until the act has been amended. This group includes Bryn Mawr, Haverford, Swarthmore, Princeton, and Reed. It has been noted that officials of a number of other institutions were not aware of the requirement embodied in Section 1001 (f) until after they had become participants in the loan program.

Some of the college presidents an-

nounced their opposition in strong terms. Charles F. Phillips of Bates, James S. Coles of Bowdoin, and J. Seelye Bixler of Colby issued a joint statement that the disclaimer provision constitutes a "serious threat to academic freedom." Hugh Borton of Haverford said that the requirement "is tantamount to signing away one's right to freedom of thought, as well as endorsing a Government action which makes the individual's opportunity for education contingent on his personal beliefs." Courtney Smith of Swarthmore observed: "It is as though we asked our children to take an oath that they love us before we gave them their allowance."

Professional Organizations Speak Out

In addition to the American Association of University Professors, other major professional educational organizations have taken a firm stand on the issue and have approved emphatically worded resolutions.

The Association of American Colleges polled its 750 member institutions and adopted a statement that disapproves the disclaimer affidavit and urges its repeal. The American Council on Education's Committee on Relationship of Higher Education to the Federal Government voted unanimously to support the elimination of the disclaimer oath; the majority of the committee also believed the oath of allegiance to be "unnecessary and undesirable." The State Universities Association has announced that it is opposed to all disclaimer oaths. And finally, the American Association of Land-Grant Colleges and State Universities, which represents 92 institutions, has reported that it opposes disclaimer oaths "except in cases of employment directly and clearly related to national security."

Congressional Action

The legislation on repeal of the loyalty provisions that is being considered by Congress is for the most part brief and to the point. Representative Frank Thompson, Jr. (D-N.J.), introduced the first of the five bills before the House, HR 284 (the only one of the group that also contains other recommendations), on the opening day of the 86th Congress. His bill asks that the disclaimer oath be omitted and the oath of allegiance retained, as do two other bills, those of Representative James Roosevelt (D-Calif.), HR 2437, and Representative Peter Frelinghuysen, Jr. (R-N.J.), HR 2332. It should be noted that Frelinghuysen has often been the sponsor of Administration legislation. The two other House bills, HR 4038 and HR 4066, were introduced by Representative James C. Oliver (D-Me.) and Representative Edith Green (D-Ore.), respectively. They both propose elimination of the entire subsection.

The bill before the Senate, S 819, which is sponsored jointly by Senator John Kennedy (D-Mass.) and Senator Joseph Clark (D-Pa.), also proposes that all of Section 1001 (f) be deleted from the Education Act. In a speech on the Senate floor in connection with the introduction of his bill on 30 January, Senator Kennedy commented on the singling out of recipients of federal scholarships and student loans and not those who "receive old age benefits, crop loans or other unrelated payments." At the end of his talk, in a reference to the fact that the National Defense Education Act had been set up especially to develop scientific talent, Kennedy observed:

"But surely, in our efforts to attract into scientific pursuits the best talents, the most inquiring minds of our nation, we do not wish to exclude the non-conformists and the dissenters. . . .

"And we in the Congress should be concerned . . . as to whether this unnecessary, futile gesture . . . will not defeat the very purposes of last year's bill. For, unlike the Soviets, we cannot take steps to keep our brightest minds *in* scientific careers—but we can take steps that keep them *out*."

Senator Kennedy's remarks are a reminder that so far scientists and scientific societies have not taken a stand on the loyalty provisions of Section 1001 (f). Spokesmen for some of the major professional educational organizations are attributing this to timidity.

Committee on Bio-Astronautics Established by Academy of Sciences

The National Academy of Sciences-National Research Council is organizing a committee which will advise the Armed Forces in any matter concerning the biological or medical aspects of space exploration. The group, called the Armed Forces-National Research Council Committee on Bio-Astronautics, will have more than 100 members, of whom at least half will be nominees of the various military services. It will serve as a conference or forum of active investigators, meeting periodically to review scientific and technical problems, exchange information, and establish liaison between investigators with allied interests. In addition to the basic goal of "providing specific answers to specific problems posed by the Armed Forces," the committee will direct its attention to other related matters. Among these matters, as developed at a recent organizational meeting, are the dissemination of research information on bio-astronautics, stimulation of research on hitherto neglected problems, and the acquainting of scientific investigators with problems that the military faces in making space an operational medium for man.

The committee, which will be administered by the Academy-Research Council's division of medical sciences, will concern itself with any field of science or technology that it finds necessary in the pursuit of its objectives. Major fields that will bear on the committee's work will be astronautics, biology, chemistry, medicine, physiology, and psychology.

In structure and origins the new group will be similar to the Armed Forces-NRC committees on vision and bioacoustics which have been in operation under the Academy-NRC division of anthropology and psychology since 1945 and 1952 respectively. Financial support for the new group is being provided equally by the three services, with the Air Force serving as the contracting agency.

Origins of Committee

In the early spring of 1958 a group of military men working in research and development discussed the need for a group similar to the existing Armed Forces-NRC committees to devote its attentions to the field of bio-astronautics. A planning group was set up, working procedures formulated, and a draft recommendation was submitted to Detlev W. Bronk, president of the National Academy of Sciences.

Bronk accepted the proposal and work began on organization. The first group formed was an executive council consisting of three military members, six persons from the Academy-Research Council membership, and three ex-officio members. In November of last year 66 specialists from the research and development branches of the three services were appointed to serve on the committee. A second group of committee members, to be appointed from the academic world and industry, will bring the membership up to 100 or more.

Relationship to Other Agencies

At present there are three other committees in either the government or the national scientific organizations that are concerned with bio-astronautics. One comes under the National Aeronautics and Space Administration, one under the Advanced Research Projects Agency and the Research and Engineering unit of the Defense Department, and a third is also a sub-unit of the National Academy of Sciences-National Research Council. In an interview, Sam F. Seeley, acting executive secretary of the new committee, said great care has been taken to make the various committees contributive to one another, rather than competitive. Seeley suggested that two factors, in practice, accomplish this end. The first is that each committee has a significantly different orientation. Thus, the Life Sciences Committee (the Lovelace Committee) of NASA is designed

to meet the needs of that agency's Project Mercury, a civilian program in which a man will be sent into orbit at a 100-mile altitude for 24 hours or less. The Advisory Committee for Man in Space serves the needs of the Defense Department's Advanced Research Project Agency and the Research and Engineering unit, military agencies with many bio-astronautical problems peculiar to their missions. The Psychological and Biological Research Committee of the Academy of Sciences' Space Science Board serves the function of providing a long, broad view of bio-astronautical problems and contributing to the thinking, the "philosophy," that gives the basic orientation to future research and development in bio-astronautics.

A second factor that works to avoid duplication, or more exactly, quadruplication, is what would be called the "interlocking directorate." As it applies to these four committees, the term means that an individual serves on more than one committee. For example, Don D. Flickinger of the Air Force is a member of both the NASA committee and the new Armed Forces-NRC group; Otto H. Schmitt, chairman of the latter committee, is also a member of the Defense Department's Man in Space group and of the Psychological and Biological Research Committee. There are numerous cases of such multiple membership. The effect of this arrangement, which reflects both planning and the fact that there are only so many qualified men in bio-astronautics, is obvious: on the one hand, repetition of effort will be avoided; on the other, "cross fertilization" will work in the favor of each committee.

Major Subjects of Study

As the result of two meetings of the committee's executive council, panels are now in the process of organization. These groups will address themselves to major problem areas of immediate concern as outlined by the council. These areas are: information in space biology fields, general biological problems of extra terrestrial life, closed ecological systems, bio-instrumentation for space experimentation, accelerational stress of ballistic rocket system, space orientation, space psychology (sensory deprivation, selection, isolation), space radiation biology, bio-engineering of protective systems, and specifications of unanswered problems in bio-astronomics.

Membership of Executive Council

Policy decisions and the programming of activities within the committee are the responsibility of the executive council. The following scientists—representing different fields of endeavor in universities, private research organizations, and the armed forces—have been appointed to the council by Detlev W. Bronk, president of the Academy-Research Council: chairman, Otto H. Schmitt, department of physics, University of Minnesota; vice chairman, Melvin Calvin, department of chemistry, University of California, Berkeley; Howard J. Curtis, department of biology, Brookhaven National Laboratory; Paul M. Fitts, department of psychology, University of Michigan; Don D. Flickinger, Directorate of Life Sciences, Air Research and Development Command; John D. French, department of anatomy, University of California Medical Center, Los Angeles; Charles F. Gell, Office of Naval Research; James D. Hardy, U.S. Naval Air Development Center, Johnsville, Pa.; and Robert H. Holmes, Research and Development Command, Office of the Surgeon General, Department of the Army.

The ex-officio members of the council are R. Keith Cannan, Academy-NRC chairman of the division of medical sciences; Sam F. Seeley, professional associate of the NRC staff, who is acting executive secretary of the committee; and K. Cutler, Air Research and Development Command, who is the contracting officer representing the military services.

Scientific Information

The International Conference on Scientific Information, which was held in Washingon, D.C., 16–21 November 1958, under the sponsorship of the National Academy of Sciences–National Research Council, the National Science Foundation, and the American Documentation Institute, was the culmination of nearly 3 years of planning [*Science* **128**, 464 (29 Aug. 1958); **128**, 1126 (7 Nov. 1958)].

Background

Some 10 years before, a similar conference had been convened by the Royal Society in London, and in a certain sense this was a 10-year follow-up. There was an important difference, however. In 1948 it was still feasible to discuss in a single conference the entire problem of scientific information: primary publication, dissemination, abstracting and indexing, and financial and administrative problems relating thereto.

But the magnitude of this whole field of activity has swelled so rapidly with the steadily increasing volume of research that it no longer seemed practical to cover so broad a range of topics in 1958. A few years ago the National Academy of Sciences–National Research Council convened a relatively small conference on one aspect of the problem, primary publication; the recent international conference was concentrated on another aspect, storage and retrieval of information.

In another sense the International Conference on Scientific Information was more specialized than its predecessors, for a serious effort was made to concentrate primarily on the technical problems involved in storing and retrieving information without becoming involved with administrative and financial questions, except in a single session.

Organization

The opening session, on Sunday evening, 16 November, featured a formal but delightful address by Sir Lindor Brown, secretary of the Royal Society of London. Remarks of welcome on behalf of the sponsors of the conference were made by Detlev W. Bronk, president of the Academy–Research Council, Alan T. Waterman, director of the National Science Foundation, and Milton O. Lee, who represented the American Documentation Institute throughout the period of organization of the conference.

The discussions were organized in an unusual way, for the reading of papers contributed to the conference was expressly prohibited. Instead, the papers were distributed to all participants well in advance of the conference. The sessions were discussions led by panels. More than 70 scientists and information specialists, who usually were not authors of papers, took part as members of the panels. The authors also engaged in the discussions. There were approximately 150 active participants in all. In addition, nearly 1000 nonparticipating observers attended the sessions, and almost as many were prevented from attending by the limitation of space.

Less intense but perhaps equally rewarding activities during the conference were tours to some of the important information processing agencies in the Washington area and visits to an exhibition adjacent to the conference hall, where a number of significant systems and components were displayed by their manufacturers or proponents.

Sessions

It would be a bold individual indeed who would pretend to present a fair summary of the content of such a conference, but I will give some of my own impressions of it. Others may draw their own conclusions when the conference proceedings are published and available from the Academy–Research Council sometime in the coming months.

Everyone agreed with the truism that requirements of users should determine the design of new systems, but there was little agreement about what these requirements, in fact, are, how they vary from subject to subject, from country to country, and with the nature of research (pure or applied). Nor was there agree-

ment on how best to determine answers to these questions. It was apparent from the discussions that verbal communication (at conferences and symposia, at table, or in the hall) is relied upon much more than is commonly supposed. Abstracts are relied upon less, and critical, comprehensive review articles of broad segments of the literature are desired very much. This does not necessarily indicate that more conferences or more financial support for existing systems will solve the problems; instead, it may emphasize the need for improved or even fundamentally new systems.

Centralization versus decentralization of services was considered in very interesting discussions in which the protagonist of centralization was A. I. Mikhailov, director of the All-Union Institute of Scientific and Technical Information of the Soviet Academy of Sciences. Mikhailov's institute has performed remarkable feats of service; nevertheless, there were many who regarded such a mammoth, government-operated organization as an impractical means for solving the problem in the United States.

A middle position was described by a Polish participant, A. Majewski, who is director of the Central Institute of Scientific and Technical Documentation in Warsaw. The scanning and abstracting of the world's literature in Poland is divided among some 80 specialized research centers there and is carried on by working scientists and engineers. A central headquarters, under Majewski's direction, controls the machinery for assembling, duplicating, and distributing information from the specialized centers and carries out a number of services, such as preparation of card indexes for distribution, that could be done locally only with much repetition and inefficiency.

These discussions will no doubt be of great interest to those considering the several proposals for a national scientific and technical information service in the United States, one such proposal having been made by the Council for Documentation Research to the Academy–Research Council.

Trends

Two quite different trends in the thinking at the conference were apparent in discussions of how to deal with the steadily increasing flow of information. What might be called the classical approach demands self-restraint at all levels, for in this view less should be published in the first place and more should be eliminated from the retrieval systems; editors should reject more papers, and abstract services should become more critical and should process only what is worth while.

The other approach would regard the classical position as one to be approved in principle, but hopeless in practice. Instead, we must develop mechanized systems with such capacity, speed, and selectivity that they can absorb all that is produced and serve up to their users only what they want. The designers of large-scale, high-speed computers were more sanguine about the future of this trend than the librarians and the using scientists, although the evidence of progress that they presented was encouraging.

Certainly the need for cooperation among using scientists and librarians on the one hand and mathematicians, engineers, linguists, and logicians on the other was made more evident. As C. W. Cleverdon, a participant from England, put it:

"These people who are trying to find out what we, the librarians, are doing, and trying to find out how we should do it, are working toward the aim of eliminating any necessity for us to do it at all. . . . Yet, as librarians, we should not abrogate our right and duty to tell all who come into documentation from outside what are our problems, and try to direct their efforts toward the solution."

Perhaps the conference laid the basis for closer cooperation of this kind. Certainly Sir Lindor Brown made us feel that in this respect the conference had been worth while when he interjected very nearly the last remark in the conference record. He said:

"We started this week speaking about *your* conference. We finished by speaking about *our* conference. What better praise could there be?"

CHARLES I. CAMPBELL
Rockefeller Institute,
New York, N.Y.

Cloud Cover Satellite

A small satellite, designed to produce pictures of the earth's cloud cover, has been put into orbit at an altitude ranging from 929 to 2086 miles. This is the first of the space vehicles designed for meteorological purposes. The satellite, weighing 20½ pounds and having a diameter of 20 inches, was launched from Cape Canaveral 17 February as a part of Project Vanguard, a program originally set up for the International Geophysical Year, which ended last December.

The sphere carried two transmitters, a receiver, a recorder, and batteries in addition to the two photocells which alternately scan the earth's cloud cover during daylight hours. Solar cells operate a switch which halts the recording tape when the satellite is in the shadow of the earth.

Clouds and sea and land masses have different qualities of reflection which can be translated into electrical impulses. As the satellite's photocells sweep the sunlit side of the earth, the intensity of sunlight reflected from the cloud areas (80 percent) will differ from that reflected from the land (15 to 20 percent) and sea (5 percent) areas. These reflections, converted to electrical signals, are stored in the tape recorder within the satellite for telemetering to ground stations in compressed form when the satellite is "interrogated"—that is, the transmitter is activated by a ground signal.

The Vanguard program, originally a Navy activity, was transferred last fall to the National Aeronautics and Space Administration. T. Keith Glennan, administrator of NASA, announced the successful shot and relayed President Eisenhower's personal congratulations to the scientists responsible for it.

National Manuscript Catalog

The Council on Library Resources, Inc., Washington, D.C., has made a grant of $200,000 to the Library of Congress to initiate work on a National Union Catalog of Manuscript Collections. It is hoped that this catalog will eventually record all collections of manuscripts in libraries and archives in the United States. The immediate goal is to bring together uniform descriptions of some 24,000 known collections in approximately 75 cooperating repositories, in addition to some 3000 collections in the Library of Congress itself, and to print and sell separate catalog cards for each of these collections so that any library that wishes to do so may maintain a similar record.

A need for a central national inventory of manuscript collections has long been felt by people involved in studies which depend upon such sources. These studies include not only civil, military, and social history but also literary history and criticism, history of the arts, biography and genealogy, paleography, business and economic history, history of science, and legal history and inquiries.

Grants, Fellowships, and Awards

Literature of science. The Phi Beta Kappa Senate has established an annual prize of $1000 for an outstanding contribution to the literature of science. The first award will be made next December to the author of the best book on science or the interpretation of science published between 1 July 1958 and 30 June 1959.

The purpose of the award is to stress the need for literate and scholarly interpretations of the physical and biological sciences and mathematics, and to symbolize the importance of science as a part of humanistic studies. Such books as *Deserts on the March,* by Paul B. Sears; *The Immense Journey,* by Loren

Eiseley; *Of Stars and Men,* by Harlow Shapley; and *Mathematics: Queen and Servant of Science,* by Eric Bell, are examples of the kind of scientific scholarship the award is to cover. It will go to a scientist, rather than to a science writer, and the book will be one written for the intelligent general public, not for other scientists.

SEATO. The South-East Asia Treaty Organization research fellowship program for 1959–60 is designed to encourage the study and research (preferably leading to publication) of such social, economic, political, cultural, scientific, and educational problems as give insight into the present needs and future development of the treaty area, viewed against a background of SEATO objectives. A limited number of advanced research fellowships is offered for 1959–60 to candidates from member states (Australia, France, New Zealand, Pakistan, the Philippines, Thailand, the United Kingdom, and the United States). A candidate must be a national of a member state and should plan to undertake his research in SEATO countries situated within the treaty area. Study in other countries may be authorized only under exceptional circumstances. The applicant's project should be of interest to SEATO and, preferably, to two or more SEATO member countries, rather than to a single one.

Grants are intended for well-established scholars. Candidates will be selected on the basis of their special aptitude and experience for carrying through a major project of research. Academic qualifications (preferably the doctoral degree or its equivalent), professional experience beyond the completion of training, and published material will be taken into account.

Preliminary screening of American candidates will be by the Committee on International Exchange of Persons of the Conference Board of Associated Research Councils, which will recommend candidates to the Department of State and the President's Board of Foreign Scholarships. The board in turn will nominate a small panel of scholars for consideration, along with similar panels from the above-named countries, by the SEATO Selection Committee in Bangkok. The awards will be made from this total list of candidates from all the member countries. Final selection of candidates will be announced by the Bangkok committee in August 1959. It is expected that only one or two grants will be available to candidates from the United States.

The grant will provide a monthly allowance of $400 and tourist-class return air travel to the country or countries of research. Grants may be authorized for periods of from 4 to 10 months. Application forms and additional information may be obtained from the Conference Board of Associated Research Councils, Committee on International Exchange of Persons, 2101 Constitution Ave., Washington 25, D.C. Applications should be submitted *no later than 15 April.*

News Briefs

Sweden has decided to postpone the development of her own uranium resources for her atomic power plant. Instead, the government proposes to study the possibility of importing the necessary fissionable material, which is expected to be less expensive than exploiting the plentiful but low-grade Swedish deposits.

* * *

The U.S. Atomic Energy Commission has recently inaugurated a revision sheet service for keeping the Trilinear Chart of Nuclides up-to-date. This service is available on a subscription basis from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.

* * *

About 438 million acute illnesses, involving either restricted activity or medical attention or both, occurred among the American people during the year ending 30 June 1958. The number of such illnesses averaged 2.6 for every person in the population. The figures are from the newest report of the U.S. National Health Survey, which shows also that the incidence was highest in the youngest age groups and decreased progressively in each older age group. The rates ranged from an average of four illnesses among children under 5 to 1.6 illnesses per person 65 or over. The incidence among females was slightly higher than it was among males.

* * *

The Endocrinology Study Section, National Institutes of Health, has announced that it is prepared to distribute, free of charge to qualified investigators, limited amounts of purified sheep pituitary follicle-stimulating hormone. The preparation has been packaged in two forms: (i) vials containing 5 mg for use only as a standard in assay procedures; (ii) vials containing 25 mg for experimental use. Application for supplies, either of the standard or of the experimental lots, should be made by letter to Dr. R. T. Hill, Executive Secretary, Endocrinology Study Section, National Institutes of Health, Bethesda 14, Md.

* * *

The General Electric Company has received the American Meteorological Society's annual Award for Outstanding Services to Meteorology by a Corporation for work carried out at the Hanford Atomic Products Operation at Richland, Wash. The award, in the form of a citation, was presented to Herbert M. Parker, manager of the Hanford Laboratories operation, at the society's annual dinner.

General Electric, which has operated the Hanford plant for the Atomic Energy Commission since 1946, has promoted a continuing program of meteorological research and service at Hanford specifically designed to assist in such operation problems as the safe disposal of small amounts of radioactive gases in the atmosphere.

* * *

A new Mormon College was recently dedicated at Laie in Hawaii, Honolulu. Three years under construction, the $3¼ million college comprises 20 buildings with accommodations for 1000 students. It is surrounded by 6000 acres of sugarcane land purchased by the church in 1865.

* * *

The Placement Committee of the Association of American Geographers has announced a new publication, *Jobs in Geography,* a monthly news letter that is mailed to all members of the association who are interested in new or better positions and have registered with the committee. Any one who wishes to have an opening listed in *Jobs in Geography* should write to the AAG Placement Committee.

* * *

The Health Information Foundation reports that the maternal mortality rate in this country has dropped 93 percent in the last 40 years, from 61 deaths per 10,000 live births in 1915 to 4.3 deaths in 1957. In its statistical bulletin, *Progress in Health Services,* the foundation points out that one maternal death occurred in approximately 2300 live births today, compared with one maternal death for each 165 live births in 1915. Last year 4.2 million babies were born in the United States; there were 1600 maternal deaths. Had the rate of one generation ago still prevailed, the number of maternal deaths would have run as high as 28,000.

* * *

To encourage educational travel by students, the United Nations Education, Scientific and Cultural Organization has issued the tenth edition of *Study Abroad,* which this year lists more than 75,000 fellowships, in contrast to 15,000 offers contained in the first edition. Each listing in *Study Abroad* includes complete details on where to apply for fellowships and scholarships, who is eligible, the field of study, the length of course, the amount of the award, and other pertinent data. The publication is available at $3 per copy, paper-bound, from the UNESCO Publications Center, 801 Third Ave., New York; the Columbia University Press, 2960 Broadway, New York; and the United Nations Bookshop.

Proposed Legislation

Since the opening of Congress on 7 January a record number of bills have been introduced. Of these many are of interest to the scientific community in that they are concerned with education, conservation, research and development, the scientific agencies, and other activities relating to science and technology. The numbers and précis of some of the major bills are given below.

(Bills are prefixed with HR in the House of Representatives, S in the Senate, followed by a number. Joint Resolutions are designated HJ Res or SJ Res; these can become law just as bills do. Concurrent Resolutions are designated H Con Res or S Con Res; these do not become law. Resolutions are designated H Res or S Res; these do not become law and are adopted only by the chamber that originates them.)

HR 127. Create an Agricultural Research and Industrial Board; define its powers and duties. Kee (D-W.Va.). Agriculture.

HR 886. Amend Watershed Protection and Flood Prevention Act re measures for erosion control. Natcher (D-Ky.). Agriculture.

S 491. Provide for establishment of a National Science Academy, a program of scientific scholarships, and encouragement of study of mathematics and science by assisting states in providing science education. Gore (D-Tenn.). Labor and Public Welfare.

HR 12. Provide for establishment of a special $18.5 million, 7-year program of federal scholarship and fellowship grants to individuals and a $2.5 million program of grants to public and nonprofit institutions of high education; encourage and expand training of teachers for education of exceptional children. Sullivan (D-Mo.). Education and Labor.

HR 284. Amend National Defense Education Act of 1958 to provide for 20,000 national defense scholarships. Thompson (D-N.J.). Education and Labor.

HR 3043. Amend Communications Act of 1934 to establish a program of federal matching grants for construction of television facilities to be used for educational purposes. Moulder (D-Mo.). Interstate and Foreign Commerce.

S 79. Amend Federal Food, Drug, and Cosmetic Act to permit temporary listing and certification of Citrus Red No. 2 for coloring mature oranges under tolerances found safe by the Secretary of Health, Education and Welfare. Holland (D-Fla.). Labor and Public Welfare.

S 256. Provide for establishment of Bureau of Older Persons with Department of Health, Education, and Welfare; authorize federal grants to assist in development and operation of studies and projects to help older persons. Magnuson (D-Wash.). Labor and Public Welfare.

S 535. Protect public health by regulating manufacture, compounding, processing, and distribution of habit-forming barbiturate and amphetamine drugs. Hennings (D-Mo.). Labor and Public Welfare.

SJ Res 1. Establish a commission to study alcoholism in the U.S. and to make recommendations for more adequate provision of facilities for treatment, rehabilitation, and cure of alcoholics, and for prevention of alcoholism. Johnston (D-S.C.). Labor and Public Welfare.

HR 408. Direct Secretary of Commerce, acting through the National Bureau of Standards, to conduct research on the effect on human health of certain products of fuel combustion. Roberts (D-Ala.). Science and Astronautics.

HR 866. Require the Surgeon General to undertake a special research program on cystic fibrosis. Multer (D-N.Y.). Interstate and Foreign Commerce.

HR 1298. Provide that the Secretary of Commerce furnish weather reports to certain air-pollution control agencies. McDonough (R-Calif.). Interstate and Foreign Commerce.

HR 1353. Authorize and request the President to undertake to mobilize at some convenient place in the U.S. an adequate number of outstanding experts, and coordinate and utilize their services in a supreme endeavor to discover means of curing and preventing cancer. Staggers (D-W.Va.). Interstate and Foreign Commerce.

HR 1360. Protect the public health by amending Federal Food, Drug, and Cosmetic Act to provide for safety of chemicals in cosmetics. Sullivan (D-Mo.). Interstate and Foreign Commerce.

HR 1942. Provide research and technical assistance on the control of salt-marsh and other pest mosquitoes of importance to public health and control of mosquito vectors of human disease. Rivers (D-S.C.). Interstate and Foreign Commerce.

HJ Res 129. Establish in Department of Health, Education and Welfare a National Advisory Council for International Medical Research, and establish in the Public Health Service the National Institute for International Medical Research. Fogarty (D-R.I.). Interstate and Foreign Commerce.

HR 174. Provide for issuance of not more than 25,000 special nonquota immigrant visas annually to certain persons who escape from the Union of Soviet Socialist Republics and whose services are determined by the Attorney General to be urgently needed in the U.S. Lane (D-Mass.). Judiciary.

HR 2323. Make the calendar fixed and perpetual. Burns (D-Hawaii). Foreign Affairs.

HR 2785. Establish an effective student exchange program with Latin American countries. O'Hara (D-Ill.). Foreign Affairs.

HJ Res 46. Establish a Commission on Utilization of Manpower in the United States. Dollinger (D-N.Y.). Education and Labor.

HR 297. Amend part IV of subtitle C of title 10, United States Code, to authorize the Secretary of the Navy to take possession of the naval oil shale reserves. Vinson (D-Ga.). Armed Services.

HR 720. Provide for the establishment of a United States Armed Forces Medical Academy. Bennett (D-Fla.). Armed Services.

S 586. Establish a U.S. Department of Science. Kefauver (D-Tenn.). Aeronautics and Space Sciences.

HR 1257. Provide for research into and development of practical means for the utilization of solar energy. Hosmer (R-Calif.). Science and Astronautics.

Scientists in the News

WALKER L. CISLER, president of the Detroit Edison Company, has been appointed president of the Thomas Alva Edison Foundation, Inc., New York. He succeeds the late Charles F. Kettering.

W. BARRY WOOD, JR., vice president of the Johns Hopkins University and Hospital and professor in the department of microbiology, has been appointed chairman of the department of microbiology. The chairmanship has been held by Dean Thomas B. Turner. In order to devote full time to teaching and research, Wood will give up the vice presidency.

MAURICE L. HIGGINS, research associate with the Eastman Kodak Company and a specialist in high-polymer chemistry, has joined the physical sciences division of Stanford Research Institute, Menlo Park, Calif., as manager of the physical chemistry section.

HANSON BLATZ has resigned as chief of the radiation branch of the Atomic Energy Commission's Health and Safety Laboratory and has been appointed radiation consultant to the city of New York and associate professor of Industrial Medicine at New York University–Bellevue Post Graduate Medical Center.

B. R. STANERSON of Washington, D.C., director of membership affairs of the American Chemical Society, has been elected president of the Scientific Manpower Commission for 1959. He succeeds HENRY A. BARTON of the American Institute of Physics, who will continue as a member of the commission.

The American Meteorological Society's Award for Applied Meteorology was made posthumously to CARL-GUSTAF A. ROSSBY, former president of the society, at the society's recent annual dinner in New York.

ERNEST W. BRACKETT has been appointed director of procurement and contracting at the National Aeronautics and Space Administration. He was formerly contract specialist and consultant to the director of procurement and production at Headquarters, Air Materiel Command, U.S. Air Force, Wright–Patterson Air Force Base, Dayton, Ohio.

LLOYD T. DEVORE, electronics research scientist, has been appointed to organize a research division for the Hoffman Electronics Corporation, Los Angeles, Calif. DeVore, former general manager of the Electronics Division, Stewart-Warner Corporation, will serve as corporate vice president and director of the new division, to be known as the Hoffman Science Center. Temporary facilities will be established in Santa Barbara, Calif., pending construction of a research facility in that area. The new center will be staffed by engineering scientists with well-rounded academic and industrial research experience, each with an established reputation in his own field.

Recipients of the seventh annual Glycerine Research awards of the Glycerine Producers' Association, New York, are as follows.

L. A. GOLDBLATT and R. S. McKINNEY, both of the Southern Utilization Research and Development Division of the U.S. Department of Agriculture, New Orleans, La., received the first award of $1000 and an honor plaque for their work on synthesis and examination of the unique physical properties of tung oil monoglycerides.

DYMTRO BUCHNEA, assistant professor of chemistry at the University of Toronto, received the second award of $300 and an honor certificate for extensive research on the analysis, synthesis, and chemical structure of unsaturated glycerolphosphatides and related compounds, natural derivatives of glycerine found in the tissue of living cells.

The third award, of $200 and an honor certificate, was given to HERMAN B. WAGNER, director of chemical research for the Tile Council of America, for the development of an improved glycerine-containing mortar for setting ceramic tiles.

HORACE A. GIDDINGS, chairman of the department of mathematics at New York University's College of Engineering, has been named director of the university's Graduate Center at the Bell Telephone Laboratories in Murray Hill, N.J. The center provides for Bell employees a program of study leading to advanced engineering degrees.

SIDNEY S. SHAMIS, associate professor of electrical engineering, has been acting director of the center since its establishment in 1957. He will return to full-time teaching and research work at the College of Engineering.

JORN L. McHUGH, director of the Virginia Fisheries Laboratory at Gloucester Point since 1951 and professor of marine biology at the College of William and Mary at Williamsburg, has taken up his duties as chief of the division of biological research of the Bureau of Commercial Fisheries, U.S. Fish and Wildlife Service. He succeeds ALBERT L. TESTER, who resigned several months ago to accept a professorship at the University of Hawaii.

DONALD G. LIVINGSTON, formerly senior research analyst in the Operations Research Unit of the Prudential Insurance Company, Newark, N.J., has been appointed assistant director of the Laboratory of Psychological Studies, Stevens Institute of Technology.

JOSEPH J. DOWNING, formerly acting director of the Mental Health Research Unit, New York State Department of Mental Hygiene, has been appointed program chief, Mental Health Services, San Mateo County Department of Public Health and Welfare, San Mateo, Calif.

The Division of Mathematics of the National Academy of Sciences–National Research Council has announced that HARRY POLACHEK, technical director of the applied mathematics laboratory at the David Taylor Model Basin, Washington 7, D.C., has been appointed chairman of the editorial committee for the quarterly journal *Mathematical Tables and Other Aids to Computation*. He succeeds C. B. TOMPKINS of the University of California at Los Angeles, who has held the post since November 1954. Articles for publication should be addressed to Polachek; information on subscriptions may be obtained from the NAS–NRC.

EDWARD R. PINCKNEY, associate in the department of medicine at Northwestern University, has been appointed director of the comprehensive medicine clinic at the university's medical school. He will also be in charge of preventive medicine and public health teaching.

In addition, Pinckney will serve as executive secretary of the committee for an integrated program for education in medicine at Northwestern. This committee is studying the feasibility of combining the premedical and medical-school years into one integrated curriculum.

L. LEON CAMPBELL, JR., associate professor and associate bacteriologist at the Laboratory of Microbial Biochemistry, Institute of Agricultural Sciences, State College of Washington, Pullman, has been appointed associate professor of microbiology in the department of microbiology, Western Reserve University, Cleveland, Ohio.

PAUL E. STEINER, formerly professor of pathology at the University of Chicago, has been appointed a senior member of the Institute for Cancer Research, Philadelphia, Pa.

NILS E. LINDENBLAD, a fellow of the RCA Laboratories technical staff at Princeton, N.J., and LORNE D. ARMSTRONG, a senior engineer in advanced development at the RCA Semiconductor and Materials Division, Somerville, N.J., are the recipients of the Radio Corporation of America's David Sarnoff Outstanding Achievement Awards in Science and Engineering. The awards, established in 1956 to commemorate the 50th anniversary in radio of General David Sarnoff, chairman of the RCA board, are presented annually by the corporation to honor outstanding achievement by a scientist and an engineer of RCA.

MYRON E. WEGMAN, secretary general of the Pan American Sanitary Bureau, Washington, D.C., and former professor and head of the department of pediatrics at Louisiana State University Medical School, has received the 1958 Clifford G. Grulee Award of the American Academy of Pediatrics.

PAUL LACOMBE, head of the department of metallurgy and director of the Research Center at the School of Mines, Paris, France, has been appointed to the newly created Republic Steel Corporation chair of metallurgy at Case Institute of Technology. He will teach a graduate course in metallurgy and participate in the research program during the spring semester. Lacombe is also professor of nuclear metallurgy at the National Institute of Nuclear Science and Technology at Saclay, and teaches courses in applied chemistry and metallurgy at the Sorbonne.

WILLIS W. HARMAN, professor of electrical engineering and director of undergraduate electrical engineering instruction at the Stanford University School of Engineering, has been awarded the American Society for Engineering Education's $1000 George Westinghouse Prize for outstanding teaching.

ROBERT F. LOEB, professor of medicine at Columbia University since 1938, has been awarded the 1959 Kober Medal of the Association for American Physicians for his contributions to the progress of the medical sciences. The medal will be presented at the association's annual meeting which will be held in Atlantic City in May.

GEORGE C. POPPENSIEK, head of immunological investigation at the U.S. Department of Agriculture's Plum Island Animal Disease Laboratory in New York, has been appointed professor of microbiology and dean of the New York State Veterinary College at Cornell University. The appointment will be effective 1 July upon retirement of WILLIAM A. HAGAN, the present dean.

The U.S. Navy's highest civilian medal, the Distinguished Public Service Award, has been presented to HERMANN I. SCHLESINGER, professor emeritus of chemistry at the University of Chicago. The ceremony took place on 11 February at the Naval Research Laboratory, Washington, D.C. Schlesinger is noted for his basic research on boron compounds, which has contributed both to the development of solid-rocket fuels and to improved vitamin manufacture.

RUSSELL L. STEERE, formerly research biologist with the Virus Laboratory at the University of California, Berkeley, has been appointed head of the Agricultural Research Service's new Pioneering Research Laboratory for Plant Virology at the Plant Industry Station, Beltsville, Md.

SAMUEL J. AJL, chief of the microbiological chemistry section and assistant chief of the department of bacteriology at Walter Reed Army Institute of Research, has been appointed program director for metabolic biology at the National Science Foundation.

HILARY KOPROWSKI, director of the Wistar Institute of Anatomy and Biology and president of the New York Academy of Sciences, has been awarded the cross of a commander of the Ordre du Mérite pour la Recherche et l'Invention of France's Societé d'Encouragement pour la Recherche et l'Invention. The ceremony took place at the Wistar Institute Museum, Philadelphia, on 11 February.

EUNICE T. MINER, executive secretary of the New York Academy of Sciences, has been presented the cross of an officer of the order. She has lectured at the American Museum of Natural History and has participated in research expeditions for submarine studies of coral reefs and for collection of marine invertebrates.

CHARLES S. DRAPER, head, department of aeronautics and astronautics at Massachusetts Institute of Technology, and Sir GEORGE EDWARDS, managing director of Vickers Armstrong Ltd., England, have been named honorary fellows of the Institute of Aeronautical Sciences. Honorary fellowship is the institute's highest honor. Among others honored at the institute's recent annual dinner in New York were the following:

PATRICK D. McTAGGERT-COWAN, associate director of the Canadian Meteorological Service, Toronto, the Robert M. Losey Award for meteorology.

VICTOR E. CARBONARA, president of the Kollsman Instrument Corporation, the Sylvanus Albert Reed Award for practical aeronautics.

ROBERT G. LOEWY, chief technical engineer of the Vertol Aircraft Corporation, the Lawrence Sperry Award for an outstanding young man in aviation.

JOSEPH TSU CHIEN LIU of the University of Michigan, the Minta Martin Aeronautical Student Fund National Paper Award, Graduate Division.

NADENE COYNE, formerly director of the department of physical medicine and rehabilitation, Cleveland General Hospital, Cleveland, Ohio, has been appointed coordinator of training for physicians in the department of physical medicine and rehabilitation of New York University–Bellevue Medical Center and director of the Respirator Center at Goldwater Memorial Hospital.

PHILLIP L. ALGER, electrical engineer with General Electric for 40 years, retired on 1 February. For 20 years he was staff assistant to the vice president of engineering. He has been appointed adjunct professor at Rensselaer Polytechnic Institute.

One of Alger's major interests has been the development of motors and generators, particularly in the areas of calculating reactance, improving starting performance, and reducing magnetic noise. He has written two technical books since 1950 and is the holder of 12 patents.

JOHN W. TUKEY, professor of mathematics at Princeton University and a member of the mathematical research department of Bell Telephone Laboratories, has been appointed assistant director of research in communications principles at the laboratories. He will remain at Princeton as professor of mathmatics.

JOHN H. ROBERSON, manager of the Atomic Energy Commission's Dayton Area Office, Dayton, Ohio, has been appointed to the newly established post of executive director of Associated Midwest Universities. He will be located at Argonne National Laboratory, Lemont, Ill., where he will assist in implementing the use of the laboratory's research and educational facilities by staff members from the 31 AMU member institutions.

Recent Deaths

HARDY CROSS, Virginia Beach, Va.; 74; civil engineer noted for the "Hardy Cross method," a method of computing stresses in rigid frames; retired in 1951 as head of the department of civil engineering at Yale University; had taught at Brown University and at the University of Illinois; 11 Feb.

CLAUDE C. CUNNINGHAM, Manhattan, Kan.; plant breeder and a member of the agronomy department of Kansas State University from 1909 to 1920; president of the Kansas Crop Improvement Association for 8 years, and former president of the Kansas State Board of Agriculture; 12 Feb.

EUGENE F. DuBOIS, New York; 76; physiologist and specialist on metabolism; retired in 1941 as physician in chief of New York Hospital and in 1950 as professor of medicine at Cornell University Medical School; former director of the Russell Sage Institute of Pathology; 12 Feb.

Rev. FRANCIS J. FRIEDEL, Dayton, Ohio; 61; retired in 1953 as dean of the College of Arts and Science at the University of Dayton; former president of Trinity College, Sioux City, Ia.; 13 Feb.

LEILA I. GIVEN, New York, N.Y.; 74; retired associate executive secretary of the American Nurses Association; former director and professor of nursing education at South Dakota State College; director and supervisor of nursing education at the University of Wisconsin, 1940–47; coauthor of textbooks on microbiology and bacteriology as applied to nursing; 12 Feb.

JESSE P. GREENSTEIN, Washington, D.C.; 56; internationally known in cancer research; chief of the biochemistry laboratory at the National Cancer Institute, Bethesda, Md., since 1946; conducted research at the Kaiser Wilhelm Institute in Dresden, Germany; author of *The Biochemistry of Cancer* and coauthor of *Advances in Cancer Research*; 12 Feb.

JOSEPH G. TARBOUX, Ann Arbor, Mich.; 60; professor of electrical engineering at the University of Michigan since 1952; assistant director of the School of Electrical Engineering at Cornell University, 1946–52; head of the electrical engineering department at the University of Tennessee, 1929–46; at the time of his death he was establishing a new type of power systems laboratory; 6 Feb.

Book Reviews

College Teaching by Television. Report of a conference sponsored jointly by the Committee on Television of the American Council on Education and the Pennsylvania State University at University Park, Pennsylvania, 20–23 Oct. 1957. John C. Adams, C. R. Carpenter, Dorothy R. Smith, Eds. American Council on Education, Washington, D.C., 1958. 234 pp. $4.

With the big wave of prospective college students already in the secondary-school pipeline, the search for solutions to the problem of the college teacher shortage has become acute. One of the principal hopes for alleviation rests in the use of closed-circuit television broadcasts. The hope is that with the intelligent and skillful use of this mass medium, large increases in the number of college teaching personnel will prove unnecessary. For this reason, the American Council on Education and Pennsylvania State University have sponsored two major conferences on teaching by television in colleges and universities. One of these was held in 1952; the other in 1957. This volume reports the proceedings of the later conference, held at Pennsylvania State University, 21–23 Oct. 1957.

Because a great deal of experience in the use of television in higher education has been gained in this decade, the conference was able to draw upon administrators, technicians, instructors, and researchers who have devoted a large portion of their time to the problems. The conference enabled these people to present the results of these experiences and to take a hard look at some of the persistent problems in the use of televised instruction.

As C. R. Carpenter, director of the Division of Academic Research and Services at Pennsylvania State, and one of the outstanding pioneers in behavioral research in audio-visual communications, put it, "The development of 'A Perspective of Televised Instruction' is one of the principal purposes of this conference." The attempt to attain this perspective was made by first appraising the gains, if any, that have been made in televised instruction.

The principal presentation on this topic was a paper by Carpenter on some of the advantages and disadvantages of televised instruction. The principal disadvantage, stressed both by Carpenter and by many other participants, is the problem of professor-student interaction. How can students ask questions and otherwise participate in discussion when television is used as the instructional medium? A number of subsequent contributors to the conference related their experience in dealing with the problem. Perhaps the most interesting of the devices used to establish student participation is the one reported by E. P. Adkins of State University College for Teachers, Albany, New York. Multiple classrooms presided over by graduate assistants receive a televised lecture. When a student wants to say something, he raises his hand; the assistant signals the instructor by pressing a lever which turns on a red light. At a signal from the instructor, the assistant presses a lever which opens the audio circuit from his particular classroom to the studio and the other receiving rooms and closes the instructor's circuit. Adkins reports that this results in "fast-flowing discussion with no more pause than in the traditional situation."

A number of participants reported that a good deal of research of the straight-evaluation variety has been conducted, in which the effectiveness of televised instruction is compared with that of ordinary classroom teaching. Almost always these comparisons reveal no superiority for either method. The eminent Yale theorist and experimenter in the field of learning, Neal E. Miller, made the most fundamental points about this problem in his paper, which is reported on pages 28 to 42 of the book. Miller points out that research which is directed toward comparing televised instruction with ordinary live instruction has been not very imaginative. By the use of learning theory, it is possible to isolate the important variables that could be utilized in televised instruction and measure their teaching effectiveness. He points out that "studies aimed simply at comparing the two techniques, without taking into account the specific requirements of the task, are likely to produce misleading and inconsistent results. . . . We are just beginning to get sophisticated enough to advance from the stage of grossly comparing televised instruction with ordinary instruction to the stage of finding out how this new medium can be used most effectively and what particular problems it can best be used for." He then refers briefly to examples of experiments that have tested significant variables, such as audience participation, which has been demonstrated to improve learning from films primarily because it guarantees practice of the correct or desired responses.

The volume has some important shortcomings that should be mentioned. It does not, perhaps, present a complete summary of the relevant research that has been done. For example, in my judgment, the systematic program of research on audio-visual communication carried on under the auspices of the U.S. Air Force, directed by A. A. Lumsdaine, and that carried on under the aegis of the Navy's Special Devices Center, which includes the research of C. R. Carpenter and his associates at Pennsylvania State University, are highly relevant to problems of television instruction. Some of these are referred to in the selected bibliography on pages 224–226. I would particularly like to call attention to "Graphic Communication and the Crisis in Education," by Miller *et al.* [*Audio-Visual Commun. Rev.* **5** (1957)] and to *Learning from Films* by Mark A. May and A. A. Lumsdaine (Yale Univ. Press, New Haven, 1958).

In spite of this shortcoming, all college and university officers as well as television producers concerned with educational programing will find that *College Teaching by Television* is a report very much worth reading. It provides a good account of experience to date in the use of television in collegiate instruction.

NATHAN MACCOBY
Department of Psychology,
Stanford University

The Motivation, Productivity, and Satisfaction of Workers. A prediction study. A. Zaleznik, C. R. Christensen, F. J. Roethlisberger, with the assistance and collaboration of George C. Homans. Graduate School of Business Administration, Harvard University, Boston, Mass., 1958. xxii + 442 pp. Illus. $6.

This is a worthy successor to the noted Hawthorne studies of industrial behavior, to which it is ideologically related. A major conclusion of the Hawthorne research, it will be recalled, was that social factors play a major role in determining worker productivity and satisfaction. The present study attempts to apply a precise research design which will verify (or reject) a variety of hypotheses set up to predict the levels of productivity and satisfaction of industrial workers.

Three theories of worker motivation

are offered. Briefly, these are as follows: (i) external and internal rewards (worker behavior stems from external rewards, such as pay, and from rewards internal to the work group, such as status); (ii) distributive justice (worker motivation is a function of what the worker perceives as a "fair return" on his social investment, which includes considerations of age, education, seniority, and so forth); and (iii) social certitude (the notion that the worker seeks especially a condition of security in his relations with others).

The results will distress managers everywhere, for they indicate with startling uniformity that the external rewards (pay, promotion) which management can supply have almost no effect on productivity or satisfaction. The most important single determinant appears to be social status (being of the right ethnic group, age, and educational level, and having the right job classification). Also found to be important was being rewarded by the group—that is, accorded the treatment appropriate to a person of such status. People rewarded by the group tended to produce at the norm, the group-defined level. People rejected by the group might be high producers or low producers; the data do not give a satisfactory clue about why an individual went one way or the other.

The authors deserve praise for an important investigation, well planned and carefully executed. They draw black marks for poor editing of the manuscript (some sentences are virtually incomprehensible) and for failing to prepare a needed index.

ROSS STAGNER
Department of Psychology,
Wayne State University

The Practice of Sanitation. Edward S. Hopkins and Wilmer H. Schulze. Williams and Wilkins, Baltimore, Md., ed. 3, 1958. ix + 487 pp. Illus. $8.

The broad field of environmental sanitation has been surveyed well by the authors. Extensive revisions have been made in this edition to make the text more valuable as a guide to physicians, sanitarians, nurses, and others seeking a comprehensive reference and descriptive book.

Details are lacking for most of the fields covered, with the possible exception of public water supplies, urban sewage disposal, and milk and milk products. Many good references are given at the end of each chapter so the student will not lack for adequate supporting material where necessary.

Environmental sanitation is a phase of public health which concerns many disciplines, such as medicine, nursing, sociology, engineering, entomology, food technology, the basic sciences, and the administrative arts. The reader will gain a clearer picture of the interrelationship of these many disciplines from the clear and concise presentation by the authors of this new edition.

ROLF ELIASSEN
Department of Civil
and Sanitary Engineering,
Massachusetts Institute of Technology

Patients, Physicians, and Illness. Source book in behavioral science and medicine. E. Gartly Jaco, Ed. Free Press, Glencoe, Ill., 1958. viii + 600 pp. $7.50.

This book is offered as a source book in behavioral science and medicine. The editor holds the novel title of associate professor of medical sociology (University of Texas Medical Branch). In this book he brings together the writing, research, and ideas of representatives of the behavioral sciences on varied aspects of medicine. By *behavioral sciences* he means sociology, cultural anthropology, and social psychology.

He believes that reaction against specialization in medicine (with a consequent loss of interest in the "total patient") and the wider recognition of "functional" and "psychosomatic" illness have resulted in renewed interest in the whole patient. This, in turn, has led to increased interest of medicine in the behavioral sciences, which have already been recognized by many as constituting a basic science for psychiatry and which may eventually be so recognized by all other branches of medicine.

The body of the book is by 63 authors (ten are physicians, the rest behavioral scientists) who have contributed 55 chapters, of which 20 have not been published previously. The chapters are grouped into seven sections, and the editor has written a brief synoptic passage for each section.

The first section is concerned with social epidemiology and social etiology—that is, the connnection between conditions of social stress and the onset of illness. Here one finds discussions of the relations between socioeconomic status and chronic disease and between church attendance and stress reactions affecting the cardiovascular system, and of the concept of "sociosomatic" illness, which is the sociological counterpart of "psychosomatic" illness.

The second section deals with health and the community—that is, community health practices, dietary habits, preventive health techniques, and health programs ending in success or failure. Here one learns that whether or not medical research is stimulated toward controlling a certain disease may depend on which social class is affected by it; that the community power structure affects the outcome of community health programs; and that our very concepts of health and illness depend on the cultural values and social structure of our society.

The third section deals with medicine as a social institution in its own right, having many norms, rituals, and values of its own. There are papers on folk and primitive medicine, the patient-physician relationship, normative components of hygienic practices in a tuberculosis hospital, and the relation of changes in the American family system to some social and psychological aspects of illness and treatment.

The fourth section deals with the "patient role"—the patient's orientation in a hospital, his response to pain as a function of the social class to which he belongs, his behavior as a patient if he is a Christian Scientist, or conditions which induce him to seek the help of quacks instead of authorized physicians.

The fifth section is devoted to the social process of medical education and its impact upon the student-physician, the various phases of his development from premedical training to the establishment of practice, the transformations of personal characteristics of students in a medical school, some similarities and differences between the clergy and the medical profession as they affect medical education, and the process of professionalization of the physician.

The sixth section deals primarily with the physician-patient relationship and how it is affected by the social and personal milieu of the physician and his patients. The articles involve analyses of specialization in medical practice; factors that develop good doctors or lawsuits for malpractice; the relation between surgeons and their patients in a teaching hospital; the significance of the patient's cultural environment to the practice of pediatrics; the consequences of socialized medicine in England—with its increase in "functional illness"—for the physician-patient relationship; and the relation to the medical profession of marginal nonmedical healing groups such as osteopaths and chiropractors.

The seventh section focuses on the medical setting: hospital, clinic, and office. Here one finds discussions of the social structure of hospitals; hospital ideology and communication among various categories of ward personnel; differences in organization, staffing, and operations between publicly supported and privately operated mental institutions; the functioning and structure of the hospital operating room; the effect of the status system of an outpatient psychiatric

clinic on patient care; the financial aspects of medical practice; and the social process of introducing new medication into the office practice of medicine.

It is clear from this brief and incomplete descriptive summary that this book is a tasty *smorgasbord,* with something for everybody.

The book makes no attempt to show in what systematic relationship the concepts of medicine stand with respect to the concepts of the behavioral sciences. One would expect this attempt to be made before one could accord a distinctive scientific status to the varied areas of study discussed in these chapters. Nor does the book present a truly panoramic overview of what is offered as a distinctive scientific field. Rather, from the standpoint of medical sociology as science, we are shown a collection of intriguing snapshots taken from different vantage points in a relatively unexplored but fertile landscape.

DAVID ROSENTHAL
National Institute of Mental Health, National Institutes of Health

Radioactive Isotopes in Clinical Practice. Edith H. Quimby, Sergei Feitelbert, Solomon Silver. Lea and Febiger, Philadelphia, Pa., 1958. 451 pp. Illus. $10.

This book presents in its three parts one of the best introductions to the field of clinical isotope application that has yet appeared. The selection of the material and the arrangement of the problems, as well as the formulation and presentation of the facts, reflect the immense experience gathered by the authors in presenting this course material to about 225 students in eight classes since 1954. Consequently, the basic needs of the student and of the clinician who wants to include these important techniques in his work are met with great understanding.

Part 1 ("Basic physics"), written by E. Quimby, covers the basic facts of nuclear physics, nuclear radiation, interaction of radiation with matter, biological effects, and radiation hazards and their avoidance. It is stimulating reading because of the clear and precise formulation of the problems, spiced by short but dynamic sketches of the historical background. The sketch on the discovery of the neutron is unique—it illustrates the high spirits of physicists in these years and appeals to the creative imagination of the student. The chapter on waste disposal and removal of contamination is a useful conclusion of part 1.

Part 2 ("Instrumentation and laboratory methods"), written by S. Feitelbert, gives a comprehensive survey of modern equipment and methods for measuring amount, uptake, and distribution of radioactive isotopes in vitro and in vivo. It emphasizes the qualitative as well as the quantitative aspects of the different techniques and recommends—especially in connection with autoradiography—some personal instruction and practical supervised experience. A chapter on laboratory design gives welcome hints to the newcomer.

In part 3 ("Clinical applications"), a thoughtful contribution by S. Silver, the reader finds valuable information on the use of the more common isotopes. Five of the 14 chapters are devoted to problems involving I^{131}; the rest, to applications of P^{32}, Fe^{59}, Cr^{51}, Au^{198}, Sr^{90} and Co^{60} in the diagnosis and treatment of various diseases. The preface to part 3 and the well-selected references given with each chapter are welcome features for the future research investigator and give him guidance for supplementary reading in works highly recommended by the authors of this book.

At a time when the importance of tracer and isotope techniques in biology and medicine is underscored by the bestowal of the Atoms for Peace prize on the Nobel prize winner G. de Hevesy, the student and the clinician will welcome this book, and the instructor will use it advantageously for classroom and course work. In addition, specialists in other fields, such as radiology, gynecology, surgery, physiology, and radiation biology, will get information on ways of applying isotope techniques in solving their respective problems.

Some errors, such as that on page 30 (a discrepancy between the figure legend and the text) are more a challenge to the student than a handicap, forcing him to check his knowledge and to approach his work critically.

A. T. KREBS
Radiobiology Division, U.S. Army Medical Research Laboratory and *Biology Department, University of Louisville*

A Source Book in Greek Science. Morris R. Cohen and I. E. Drabkin. Harvard University Press, Cambridge, Mass., 2nd printing, 1958. xxi + 581 pp. Illus. $7.50.

This book, first published in 1948, has become a standard text for those wishing to study the history of Greek science. It provides in English translation all the most frequently cited original passages from classical authors. For more than ten years it has been the greatest boon to teachers and students in elementary courses, and with the rapid spread of these courses it is apparent that it will continue to be invaluable for several decades to come. In 1956 the whole series of these "Source Books in the History of the Sciences" was taken over by Harvard University Press from McGraw-Hill Book Company, and it is a pleasure to compliment the new publisher on the usefulness of this printing.

The second printing differs little from the first. A few typographical errors have been corrected, and a short bibliography of recent publications has been added. In the "General Editor's Preface" (page v) one is relieved to find that all mention of a millenial plan which, a safe dozen years ago, provided for the publication, about 1960, of a volume which would contain the most important contributions of the major sciences from 1900 to 1950 has been deleted. More seriously, one could have wished for a few more editorial changes. For example, the highly misleading scheme on page 130, showing a central ellipse produced by epicycle and deferent, should have been omitted. Not only was it never used in classical astronomy and never could have been used, but it confuses the student through its apparent similarity to the noncentral Kepler ellipse orbits.

I would like to take this opportunity to point out that the similarly excellent *Source Books* in astronomy and in chemistry are also now available; it is to be hoped that the new publisher will speed the reprinting of other titles in this list and seek to extend the series further.

DEREK J. DE SOLLA PRICE
Institute for Advanced Study, Princeton, N.J.

The Chemical Behavior of Zirconium. Warren B. Blumenthal. Van Nostrand, Princeton, N.J., 1958. vi + 398 pp. Illus. $11.

This will be welcomed as the only recent book devoted to the chemistry of zirconium. Enough information on zirconium has become available to make it feasible to develop a systematic chemistry of the element, and this is the announced aim of the present book. On the whole, the author has succeeded very well. He discusses first the element zirconium under such headings as history, occurrence, extraction, and theory of zirconium chemistry. He then discusses interstitial solutions and intermetallic compounds. The remaining seven chapters discuss other zirconium compounds in the following order: halogenides, oxides and zirconates, zircon and complex silicates, sulfatozirconic acids and related compounds, compounds with other inorganic acids, carboxylates, and other organic compounds.

In discussing the theory of zirconium

chemistry Blumenthal makes the following basic points. The valence of zirconium is four in nearly all its compounds. Zirconium tends to reach the highest coordination number that is sterically possible by the addition of ions or molecules from the environment. Zirconium never forms a simple monatomic ion but is always covalently bound. In aqueous solution this means that all zirconium compounds are complex, and an explanation is thus provided for the slow reactions frequently observed, as well as for the fact that the behavior of a zirconium-containing solution often depends on its previous history. However, it will come as a surprise to many chemists to read, "it is incorrect to associate the positive charge of zirconium-containing cations with the zirconium atom. It is rather to be associated with the oxygen atom" (page 37).

Chapter 2, on interstitial and intermetallic compounds, treats zirconium carbide on the basis of Hägg's interstitial solution theory, with no reference to Rundle's work [*Acta Cryst.* **1**, 180 (1948)], which has invalidated much of this theory while providing a foundation for further advance in this field. The facts about formation and properties are, of course, not in question here.

Hafnium is mentioned only incidentally and is treated as a heavy isotope of zirconium for the purposes of this book. There are 1786 references (not all different, however), and 1866 authors' names are indexed. A thorough job of literature searching is thus indicated for this work, which will surely be a standard in the field of zirconium chemistry for many years.

ROLF B. JOHANNESEN
Inorganic Chemistry Section,
National Bureau of Standards

Nouveau traité de chimie minérale. vol. 4, group II. Glucinium, magnésium, calcium, strontium, barium, radium. Paul Pascal, Ed. Masson, Paris, 1958. xxxiii + 973 pp. Illus. Cloth, F. 8500; paper, F. 7500.

A review of volumes 1 and 10 of this work appeared in *Science* of 1 March 1957 [**125**, 401 (1957)], and that of volume 3 in the 18 July 1958 issue [**128**, 138 (1958)].

According to volume 4, the originally contemplated 19 volumes of the treatise have been extended to 20 volumes. The original volume 11, which was to cover arsenic, antimony, bismuth, vanadium, niobium, tantalum, and protactinium, will cover only arsenic, antimony, and bismuth. The other four elements named will be discussed in volume 12.

In volume 4, 125 pages are devoted to beryllium (in French, glucinium), 148 to magnesium, 266 to calcium, 200 to strontium, 182 to barium, and 28 to radium. At the end of each section bibliography the cut-off date of the literature is given.

The new volume maintains the standard of excellence of the previously published volumes; this is an indication of the care that is being taken in the preparation of this modern treatise on inorganic chemistry.

RALEIGH GILCHRIST
Division of Chemistry,
National Bureau of Standards

Project Satellite. Kenneth W. Gatland, Ed. British Book Center, New York, 1958. 169 pp. Illus. $5.

There are four chapters to this addition to the rapidly growing space literature. The first, entitled "From small beginnings," was written by Wernher von Braun and reviews rocket work in Germany from the late 1920's through the famous Peenemünde effort. Chapter 2, "The satellite project," by Kenneth W. Gatland, presents early thinking on the creation of artificial earth satellites, reviews a number of rocket developments, such as the Aerobee and the Viking, and discusses the American and Soviet satellite programs. The third chapter, by Harry E. Ross, is entitled "Orbital bases" and gives the engineering problems involved in creating and operating manned space stations. Ross reviews a number of designs for such space stations and discusses briefly their military and scientific value. In the fourth chapter, A. V. Cleaver discusses interplanetary flight, with some discussion of the advanced techniques that will have to be developed in order to achieve flight into space. Cleaver ventures some predictions about how long it will be before man will be able to take a trip to the moon, or out to the near planets, and suggests appreciably longer times than many others have given in their predictions.

All of the authors have had close association with, and long interest in, the fields about which they write, and they represent considerable technical experience and competence.

Von Braun's chapter is written in a fast-moving, lucid style and makes enjoyable and informative reading. Interest for the reader is greatly enhanced by von Braun's personal and effective role in the history he portrays. The remaining chapters are informative but rather pedestrian in style. The presentation is uninspired and unimaginative from a teaching point of view, but clear enough. For the general reader who has as yet done little reading on artificial satellites and space flight, the book can be recommended. The reader who has already read several books on the subject will probably find little that is new in this one.

HOMER E. NEWELL, JR.
U.S. Naval Research Laboratory,
Washington, D.C.

Man the Maker. A history of technology and engineering. R. J. Forbes. Abelard-Schuman, New York, rev. ed., 1958. 365 pp. $5.

"The average American of 1776," says R. J. Forbes (page 328), "used the help of one servant for two weeks in the year, while today he is the owner of sixty slaves." It is astonishing, in view of this statistic, how little interest the average American has shown in how this came about. It is scarcely less astonishing how few attempts have been made to tell him, at least in other than economic terms. This being the case, almost any book on the history of technology is welcome. This book, essentially a reissue of the 1950 edition, is doubly welcome, for it is the work of a leading authority.

One of the principal difficulties in writing such a book is the problem of organizing its varied subject matter. Forbes has managed this well and has produced what is probably the smoothest narrative account of this subject to date. Unlike some earlier historians he has not eased his task by the arbitrary elimination of certain sectors of technology. He has also succeeded notably in reducing the barrier of technical terminology. In short, even if this were not almost the only book in English on this subject, it would deserve recommendation.

The condensation inevitable in a book of this sort (the period 1830 to 1930 is covered in about 90 pages) can only be accomplished through drastic oversimplification. Forbes' treatment of the history of the windmill, steam engine, and telephone illustrate this. He is evidently steeped in these subjects, but condensation has squeezed most of the juice out of his account of them. Condensation may also have led to such misstatements as the reference to Bernard Palissy's *Discours* as an important book on mining and metallurgy (page 165); the inference that Smeaton's analysis of wind- and water-power machines was merely a report based on his observation of foreign practice (page 184); and the apparent confusion of dates in his descriptions of early sulfuric acid manufacture (page 220) and transatlantic steam navigation (pages 263–264). These and other questionable passages seem partly attributable to the exigencies of condensation and partly to Forbes' evident determination to be definite about essentially

nebulous questions of invention and discovery. It must be admitted that he could hardly have produced so brief a book on this subject had he done otherwise, but the reader would be wise to check elsewhere for the details of any particular technology.

The book is illustrated (although not particularly well) and indexed, and it has a good bibliography. It differs from the edition of 1950 only in the addition of ten pages at the end.

ROBERT P. MULTHAUF
Department of Science and Technology, Smithsonian Institution

New Books

Advances in Agronomy. vol. 10. Prepared under the auspices of the American Society of Agronomy. A. G. Norman, Ed. Academic Press, New York, 1958. 559 pp. $12.50. Contents: "Agronomic trends and problems in the Great Plains"; "Changing concepts of plant nutrient behavior and fertilizer use"; "Race 15B of wheat stem rust—what it is and what it means"; "Australian soils and their responses to fertilizers"; "Castorbeans: a new oil crop for mechanized production"; "Safflower"; "Reactions of ammonia in soils"; "New grasses and legumes for soil and water conservation"; "Role of sulfur in soil fertility"; "Corn plant population in relation to soil productivity"; "Liming."

Advances in Carbohydrate Chemistry. vol. 13. Melville L. Wolfrom, Ed. Academic Press, New York, 1958. 398 pp. $11. Contents: "Formation and cleavage of the oxygen ring in sugars"; "Lobry De Bruyn-Alberda Van Ekenstein Transformation"; "Formation reaction in carbohydrate research"; "Four-carbon saccharinic acids"; "Methyl ethers of 2-amino-2-deoxy sugars"; "Glycosyl ureides"; "Nonulosaminic acids"; "Polysaccharide hydrocolloids of commerce"; "Alkaline degradation of polysaccharides"; "Starch nitrate."

Advanced Mechanics of Fluids. D. W. Appel, P. G. Hubbard, L. Landweber, E. M. Laursen, J. S. McNown, H. Rouse, T. T. Siao, A. Toch, C. S. Yih. Hunter Rouse, Ed. Wiley, New York; Chapman & Hall, London, 1959. 458 pp. $9.75.

Anatomy and Physiology Laboratory Manual. Catherine Parker Anthony. Mosby, St. Louis, Mo., ed. 5, 1959. 320 pp. $3.50.

Biological Laboratory Data. L. J. Hale. Methuen, London; Wiley, New York, 1958. 142 pp. $2.75.

Chemical Constitution. An introduction to the theory of the chemical bond. J. A. A. Ketelaar. Elsevier, Amsterdam, ed. 2, 1958 (order from Van Nostrand, Princeton, N.J.). 456 pp. $8.95.

Cold Injury. Transactions of the Fifth Conference, 10–15 March 1957. Arctic Aeromedical Laboratory, Ladd Air Force Base, Alaska. M. Irene Ferrer, Ed. Josiah Macy, Jr. Foundation, New York, 1958. 341 pp. $5.95.

Compact Heat Exchangers. A summary of basic heat transfer and flow friction design data. W. M. Kays and A. L. London. McGraw-Hill, New York, 1958. 168 pp. $6.

Convex Surfaces. Herbert Busemann. Interscience, New York, 1958. 205 pp. $6.

Dynamics of Proliferating Tissues. Dorothy Price, Ed. Univ. of Chicago Press, Chicago, Ill., 1958. 111 pp. $3.25.

Electromagnetic Phenomena in Cosmical Physics. International Astronomical Union Symposium No. 6. Held in Stockholm, August 1956. B. Lehnert, Ed. Cambridge Univ. Press, New York, 1958. 558 pp. $10.

Elementary Practical Organic Chemistry. pt. I, "Small scale preparations"; pt. II, "Qualitative organic analysis"; pt. III, "Quantitative organic analysis." Arthur I. Vogel. Longmans, Green, New York, 1958. 918 pp. $9.75.

Elements de mathematique. vol. II, Algebre. Chapitre 8, "Modules et anneaux semi-simples." 189 pp. F. 2000.

Embryonic Nutrition. Dorothea Rudnick, Ed. Univ. of Chicago Press, Chicago, Ill., 1958. 113 pp. $3.25.

Engineering Fluid Mechanics. Charles Jaeger. Translated from the German by P. O. Wolf. St. Martin's Press, New York, 1957. 547 pp. $11.50.

Expansion Machines for Low Temperature Processes. S. C. Collins and R. L. Cannaday. Oxford Univ. Press, New York, 1958. 116 pp. Paper, $3.

The Essentials of Chemistry. R. P. Graham and L. H. Cragg. Rinehart, New York, 1959. 590 pp. $6.50.

Extensive Air Showers. William Galbraith. Academic Press, New York; Butterworths, London, 1958. 227 pp. $7.50.

Fine Particle Measurement. Size, surface, and pore volume. Clyde Orr, Jr., and J. M. Dalla Valle. Macmillan, New York, 1959. 353 pp. $10.50.

The General Science of Nature. Vincent Edward Smith. Bruce, Milwaukee, Wis., 1958. 413 pp. $7.

Génétique du vison. II. Andrée Tétry and Martial Villemin. Vigot, Paris, 1959. 215 pp. F. 2600.

Grundriss der Allgemeinen Zoologie. Alfred Kuhn. Thieme, Stuttgart, Germany, 1959. 296 pp. $4.25.

Hymenoptera of America North of Mexico. Synoptic catalog. Agriculture Monogr. No. 2, 1st Supplement. Karl V. Krombein *et al.* U.S. Department of Agriculture, Washington, 1958 (order from Supt. of Documents, GPO, Washington 25). 305 pp. $1.75.

Interference between Power Systems and Telecommunications Lines. H. R. J. Klewe. Arnold, London, 1958 (order from St. Martin's Press, New York 17). 264 pp. $12.50.

Introduction to Geophysics. Benjamin F. Howell, Jr. McGraw-Hill, New York, 1959. 410 pp. $9.

Introduction to Neutron Physics. L. F. Curtiss. Van Nostrand, Princeton, N.J., 1959. 391 pp. $9.75.

Investment in Innovation. C. F. Carter and B. R. Williams on behalf of the Science and Industry Committee. Oxford Univ. Press, New York, 1958. 178 pp. $2.40.

Irreducible Tensorial Sets. U. Fano and G. Racah. Academic Press, New York, 1959. 178 pp. $6.80.

Laboratory Instructions in Biochemistry. Israel S. Kleiner and Louis B. Dotti. Mosby, St. Louis, Mo., ed. 5, 1958. 289 pp. $3.50.

Laminated Plastics. Including high-pressure and low-pressure types and reinforced plastics. D. J. Duffin. Reinhold, New York; Chapman & Hall, London, 1958. 263 pp. $5.75.

Liquid Scintillation Counting. Proceedings of a conference held at Northwestern University, 20–22 August 1957. Carlos G. Bell, Jr., and F. Newton Hayes, Eds. Pergamon, New York and London, 1958. 303 pp. $10.

Modern Foundry Practice. E. D. Howard, Ed. Contributions by 18 specialist authors. Philosophical Library, New York, ed. 3, 1959. 464 pp. $15.

Die Muskeltätigkeit. Versuch einer biophysik des quergestreiften Muskels. Eugen Ernst. Ungarischen Akademie der Wissenschaften, Budapest, Hungary, 1958. 355 pp.

Nuclear Magnetic Resonance. Applications to organic chemistry. John D. Roberts. McGraw-Hill, New York, 1959. 126 pp. $6.

Nuclear Reactions. vol. I. P. M. Endt and M. Demeur, Eds. North-Holland, Amsterdam; Interscience, New York, 1959. 514 pp. $12.50.

Physics of Meteor Flight in the Atmosphere. Ernst J. Opik. Interscience, New York, 1958. 182 pp. Paper, $1.95; cloth, $3.85.

Polarography. In medicine, biochemistry, and pharmacy. M. Brezina and P. Zuman. Translated from the Czech by S. Wawzonek. Interscience. New York, revised English ed., 1958. 880 pp. $19.50.

The Potential Theory of Unsteady Supersonic Flow. John W. Miles. Cambridge Univ. Press, New York, 1959. 232 pp. $8.50.

Principles of Horticulture. Ervin L. Denisen. Macmillan, New York, 1958. 518 pp. $6.95.

Psychopharmacology Frontiers. Proceedings of the Psychopharmacology Symposium, Second International Congress of Psychiatry. Nathan S. Kline, Ed. Little, Brown, Boston, 1958. 556 pp. $10.

Selected Bibliographies of Hydrothermal and Magmatic Mineral Deposits. Memoir 75. John Drew Ridge. Geological Soc. of America, New York 27, 1958. 208 pp.

Soviet Economic Aid. The new aid and trade policy in underdeveloped countries. Joseph S. Berliner. Praeger, New York, 1958. 247 pp. $4.25.

Statistical Theory of Irreversible Processes. R. Eisenschitz. Oxford Univ. Press, New York, 1958. 92 pp.

Surface Phenomena in Chemistry and Biology. J. F. Danielli, K. G. A. Pankhurst, A. C. Riddiford, Eds. Pergamon Press, New York and London, 1958. 330 pp. $10.

Tables of Interatomic Distances and Configuration in Molecules and Ions. Special Publ. No. 11. L. E. Sutton, Ed. Chemical Soc., London, 1958

Reports

Relation of Geomagnetic Disturbances to Circulation Changes at 30,000-Foot Level

Abstract. From analyses of waves in the circulation pattern at the jet-stream level of the atmosphere during the winters of 1956–57 and 1957–58, it was found that, in comparison with other waves, those which appeared in the Alaska-Aleutian area about 3 days after a magnetic disturbance subsequently developed into large-amplitude disturbances.

In a recent review of solar-terrestrial relationships, Roberts (*1*) has emphasized the importance of corpuscular emissions from the sun as a possible factor in solar-weather relations. In the investigation discussed in this report, our solar index is the Cheltenham A-index (A_{CH}) of geomagnetic field fluctuation at Cheltenham, an index generally taken to measure the strength of solar corpuscular energy received at the earth.

A preliminary survey (*2*) of charts of the 300 mbar (30,000 ft or "jet stream") level, covering the half hemisphere from 180°W to 0°, indicated that "troughs" in the wave development at this level appeared to amplify or deepen more frequently following abrupt increases in the A_{CH} index than at other times (*3*). To test the magnitude of the change, an objective "trough index" (I_t) was developed. The trough index, which describes the amount of wave amplification by the degree of cyclonic curvature of a trough, was computed for all troughs from the day they first appeared at the western extremities of the charts—that is, north of 40°N, west of 120°W, and east of 180°W—until they dissipated or moved off the limits of the maps. The Alaska-Aleutian area is near the auroral zone, where, on the average, the maximum particle flux occurs in the high atmosphere. But that region was chosen because it marks the western limit of our maps, and we wanted to follow each eastward-moving trough as long as possible. Individual troughs exhibited varying values of I_t, depending on the large-scale features of the circulation, but at some time a maximum I_t occurred for each trough. From the distribution of all the maximum values of I_t, each trough was classified large, medium or small; these three classes were approximately equal.

"Magnetically disturbed days" ("A_{CH} key days") were chosen to include all those on which magnetic storms and magnetic disturbances described in the weekly "Preliminary Reports of Solar Activity" (*4*) occurred—days when, presumably, corpuscular clouds arrive from the sun. During the pilot-study period, from October 1956 through March 1957, an A_{CH} key day was defined as any day when the value of A_{CH} reached or exceeded 23 and had increased by a value equal to, or greater than, 12 over its value on the preceding day. During this period of time 19 key days occurred. It should be noted that the frequency distribution of the daily values of A_{CH} and I_t shows some skewness toward large values and that there is a slight autocorrelation ($\sim .2$) over intervals of a day or two.

The total number of troughs that had appeared before and after all the key days was then determined. Using this superposed epoch method, we found that, over the pilot-study period, troughs which appeared in the Alaska-Aleutian area about 3 days after an A_{CH} key day quite often developed into troughs with a large amplitude. To determine whether the association of trough development and A_{CH} key days was statistically significant, we compared the occurrence of large, medium, and small troughs with the occurrence of A_{CH} key days; this comparison is shown in Table 1. In the table we have listed troughs as "A_{CH}" if they first appeared in the Alaska-Aleutian area 3 ± 1 days after an A_{CH} key day and "no A_{CH}" if they appeared in the same area at any other time.

Application of the chi-square test to these data shows that the probability p of no association between A_{CH} and trough development is .01. Thus, the 1956–57 statistics support the hypothesis that larger troughs tend to follow magnetic disturbances.

Our analysis of trough development at the 300-mbar level during the past winter half year (1957–58) has just been completed. We followed the same procedure as that used in the pilot study. However, to remove any possible unconscious bias based on our knowledge of the occurrence of magnetic storms, the dates of first appearance of troughs in the Alaska-Aleutian area were determined from the maps by two meteorologists who had no prior knowledge of the behavior of A_{CH} over the study period.

Unlike 1956–57, this year there were very few abrupt increases or sharp, well-defined peaks of A_{CH}. The criterion used in the pilot study was met only nine times from October 1957 through March 1958. In order to include all the days on which magnetic storms had occurred during this period, the magnetic key days were chosen as those days when A_{CH} was equal to or greater than 21 and had increased at some time during the previous 3 days, by an amount equal to or greater than 10. Using this criterion, we found six additional A_{CH} key days (and six additional troughs) over the winter half year of 1957–58. This criterion, if applied to the 1956–57 data, would not change the number or dates of key days.

Table 2 shows the distribution of the three classes of troughs (large, medium, and small) in relation to A_{CH} key days. The designations of the columns and rows are the same as in Table 1. The numbers not in parenthesis were obtained by the lower-disturbance level criterion used in 1957–58, by which 15 key days

Table 1. Troughs and magnetic disturbances, 1956–57.

Troughs	A_{CH}	No A_{CH}	Total
Large	11	8	19
Medium	3	13	16
Small	4	15	19
Total	18	36	54

Table 2. Troughs and magnetic disturbances, 1957–58.

Troughs	A_{CH}	No A_{CH}	Total
Large	11(8)	11(14)	22(22)
Medium	3(1)	16(18)	19(19)
Small	3(2)	19(20)	22(22)
Total	17(11)	46(52)	63(63)

Instructions for preparing reports. Begin the report with an abstract of from 45 to 55 words. The abstract should *not* repeat phrases employed in the title. It should work with the title to give the reader a summary of the results presented in the report proper. (Since this requirement has only recently gone into effect, not all reports that are now being published as yet observe it.)

Type manuscripts double-spaced and submit one ribbon copy and one carbon copy.

Limit the report proper to the equivalent of 1200 words. This space includes that occupied by illustrative material as well as by the references and notes.

Limit illustrative material to *one* 2-column figure (that is, a figure whose width equals two columns of text) or to *one* 2-column table or to *two* 1-column illustrations, which may consist of two figures or two tables or one of each.

For further details see "Suggestions to Contributors" [*Science* 125, 16 (1957)].

were obtained. The numbers in parentheses show the distribution when geomagnetic key days were chosen in exactly the same manner as they were in 1956–57. On two occasions, two troughs followed a single magnetic disturbance; this accounts for the numbers 17 and (11) shown in the totals.

Both sets of data show an association of large troughs following geomagnetic disturbances. A chi-square test of the cases selected by the "loosened" A_{CH} criterion shows that the probability, p, is slightly less than .01. The p for the 1956–57 criterion is slightly greater than .02.

The assumption of a normal distribution of the underlying population of A_{CH} and I_t values necessary for chi-square tests may be questioned, but we chose this simple test because of the obvious significance of the table.

It should also be pointed out that the theoretical frequencies shown in the A_{CH} columns in both Tables 1 and 2 are only slightly larger than the minimum of five set by Yule and Kendall (*5*). But the 1957–58 sample is independent of the pilot study, and a table combining both samples would yield theoretical cell frequencies well in excess of 10 and probability, p, of less than .001.

The pilot study had also suggested that the deepening troughs reach a maximum about 8 or 9 days after an A_{CH} key day, and that this results in a maximum length of the 30,400-ft contour between 180°W and 90°W. This is not supported by the 1957–58 data.

A third hypothesis, based on the 1956–57 sample—namely, that the large troughs follow a set pattern of development—was partly supported by this year's analysis, but the statistics would not be, by themselves, significant.

We do not offer any suggestions about the physical mechanisms which must be in effect if the statistical analyses are valid. Indeed, most numerical-dynamical investigations of the vertical propagation of disturbances from high levels to the troposphere indicate that this is a weak mechanism (*6*). Thus, even though the statistical level of significance is reasonably convincing, no real confidence can be attached to the observed relationships until the analyses have been extended further in time and over a much larger area of the earth. To do this, we plan to use similar procedures at the 500-mbar (18,000-ft) level, for which data are available for the whole Northern Hemisphere back to 1946.

NORMAN J. MACDONALD
High Altitude Observatory,
University of Colorado, Boulder
DAVID D. WOODBRIDGE
Project Research Office,
Army Ballistic Missile Agency,
Huntsville, Alabama

References and Notes

1. W. O. Roberts, *Bull. Am. Meteorol. Soc.* 37, No. 9 (1956).
2. D. D. Woodbridge *et al.*, "A Possible Effect in 300 mb Circulation Related to Solar Corpuscular Emission," *Inst. Solar-Terrest. Research, High Altitude Observatory, Tech. Rept. No. 3* (1957).
3. We acknowledge the assistance of the Department of Transport of Canada, which supplied the basic analyses of the 300-mbar data, and we wish to thank Robert F. Brun and Sylvia Moscove for their work in determining the dates of origin and the types of troughs.
4. "Preliminary Reports of Solar Activity" is published weekly by the High Altitude Observatory, Boulder, Colo., with the support of the Boulder Laboratories of the National Bureau of Standards and the Air Force Cambridge Research Center.
5. G. U. Yule and M. G. Kendall, *An Introduction to the Theory of Statistics* (Griffin, London, ed. 13, 1945).
6. J. Spar, "Meteorological Models for the Study of Atmospheric Responses to Anomalous Solar Emissions," *Inst. Solar-Terrest. Research, High Altitude Observatory, Tech. Rept. No. 5* (1958).

12 September 1958

Tenderness, Climate, and Citrus Fruit

Abstract. Tenderness of coastal-grown citrus fruit to fumigation, spray, and storage practices, and to frost, as compared with fruit grown in the drier interior districts of southern California, is correlated with lower puncture-pressures and higher moisture content of peel. The hardening effect of moisture stress is also exhibited by fruit from tree tops.

It has been common horticultural experience that plants grown in submaximum light intensities and near maximum soil moisture (mesophytic habitat) are more tender than those grown in maximum light intensity and low soil moisture (xerophytic habitat). This concept of tenderness is associated with the succulence and edible quality of vegetables, but plants grown in mesophytic habitats cannot be transferred abruptly to xerophytic habitats without severe injury. Plants known to be sensitive to low temperatures may be made more resistant or "hardened" by exposure to short periods of sub-low temperatures. Tenderness in these cases has generally been associated with high moisture content.

Maximov (*1*) reviewed evidence showing the responses of leaf structure to xerophytic conditions. These responses were smaller leaf area, thicker leaves, thicker cuticles, epidermal layers, and greater palisade development. Cellular responses were those that might be associated with a lower moisture content—that is, smaller cells and thicker cell walls. Leaves appear to be the organs most sensitive to water supply and insolation and, because of their relatively simple structure, are more readily studied than other organs. But the few studies on other plant organs have not been definitive. This has been a result of the complexity of fibers, vessels, collenchyma, epidermis, and so forth, and of their cellular organization as well.

A greater sensitivity of citrus fruit grown in coastal locations in southern California to fumigation with hydrocyanic acid and to damage from oil spray (*2*) has also been referred to as tenderness. Also, it has been shown that coastal fruit keep in storage for a shorter period than fruit from the interior (*3*). Careful observers have noted also that coastal fruit freeze at higher temperatures than those growing in the desert.

A study has been recently completed in which the peels of four varieties of mature citrus fruit from four climatic districts in southern California were examined for moisture content and tenderness, as measured by the puncture-pressure of the peel. As many of the variables as possible were put under control before the fruit was randomly picked. The population was defined as (i) four varieties, (ii) two rootstocks, (iii) four climatic districts further defined by mean daily air temperature and evaporation, (iv) mature fruit, (v) without surface scars, (vi) one season, (vii) eight positions on the tree (0.5 to 6 ft high, N-S-E-W, and 6 to 30 ft high, N-S-E-W), (viii) shaded fruit, (ix) midway between irrigations, (x) commercially productive grove or equivalent, (xi) without bruises, (xii) controlled nonexperimental water loss, (xiii) moisture variation within individual fruits, (xiv) noninterplanted, (xv) nonshaded, (xvi) afternoon samples, (xvii) uniform tree spacing, (xviii) clear, quiet weather.

Five fruits were picked from low on the tree and five fruits were picked from high on the tree, at random, from each of five distantly spaced trees randomly

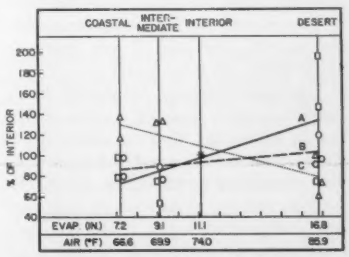


Fig. 1. Regression lines for four varieties of citrus fruit. *A*, puncture-pressures of peels; *B*, dry matter per unit volume of fresh peels; *C*, percentage of moisture in peels of whole fruit, plotted as percentage of the interior against mean daily air temperature and total evaporation for June, July, August, and September of 1955 for four climatic districts in southern California (*4*). Squares represent puncture-pressure; circles, dry matter per unit volume of fresh peel; triangles, percentage of moisture.

Table 1. Mean air temperature characterizing four climatic districts in southern California during the summers 1949–55, mean air temperature and total evaporation during the summer season during which four varieties of citrus fruit were grown (1955), and physical characteristics of the fruit peel.

Fruit	Year	Climatic district			
		Coast	Intermediate	Interior	Desert
		Air temperature (°F)			
	1949–55	66.5	71.0	73.2	86.7
	1955	66.6	69.9	74.0	85.9
		Evaporation (in.)			
	1955	7.2	9.1	11.1	16.8
		Peel moisture (%)			
Lemon	1955	448.6	—	388.3	380.9
Grapefruit	1955	—	505.9	388.1	300.3
Valencia orange	1955–56	329.3	—	242.3	273.1
Washington navel orange	1956	—	405.4	309.2	—
		Weight of dry peel per unit volume of fresh peel (g/cm^3)			
Lemon	1955	0.1737	—	0.1788	0.1700
Grapefruit	1955	—	0.0973	0.1284	0.1529
Valencia orange	1955–56	0.1726	—	0.2182	0.1982
Washington navel orange	1956	—	0.1500	0.1711	—
		Peel-puncture-pressure ($lb/in.^2$)			
Lemon	1955	1094	1123	—	833
Grapefruit	1955	—	190	254	496
Valencia orange	1955–56	258	—	332	485
Washington navel orange	1956	—	224	423	—
		Storage life			
Citrus		Short	—	Long	—
		Injured by fumigation			
Citrus		Readily	—	Not readily	—
		Injured by oil spray			
Citrus		Readily	—	Not readily	—

selected, in a randomly selected grove of a given variety in a given climatic district. Eleven groves were sampled in a 5000-mi² area; groves of the same variety were separated by the random sampling with the result that two pairs of groves were 30 air-line miles apart, one pair 38, one pair 72, one pair 107, and 2 pairs 133 miles apart.

Variation between individual fruits, heights on tree, trees in a grove, varieties in a climatic district, and between climatic districts (varieties disregarded) was measured statistically. Variables such as tree age, bud sources, pest control, cultivation, cover crop, fertilizer, frost protection, soil type, depth, water capacity, *p*H, and so forth, and irrigation water quality, irrigation quantity, irrigation interval, nutritional sprays, picking and pruning practice, wind protection, leaf surface, tree height, weed control, and so forth, which in part make up the minimum of 3.67×10^{11} permutations and combinations of variables in citrus culture, were not under control but were segregated as a group and measured as error. Peel moisture and dry weight were determined for each whole fruit peel by drying the peel to constant weight in an air-draft oven at 65°C. The puncture-pressure of the peel, the measure of tenderness used in this work, was determined by six puncture-pressure tests around the equator of each individual fruit used in the moisture and dry weight determinations.

Table 1 shows that the mean daily temperature for the four months June, July, August, and September 1955 and the six previous summer seasons (that is, for 1949–1955) is progressively higher for each climatic district in the order coastal, intermediate, interior, and desert. Fruit which were growing on the trees during these four months in the summer of 1955 were grown under a similar trend of mean air temperature and air evaporation in the four districts, as is shown in Table 1. In general, the puncture-pressure and dry weight of the peel per unit volume of peel increased from coastal to desert district, and the percentage of moisture in the peel decreased. These factors appear to be correlated with other observations of tenderness to a high degree.

The trends of these three factors with climatic district, mean air temperature, and air evaporation for the four summer months are shown in Fig. 1. The multiple correlation coefficient between the puncture-pressure of the peel (y), evaporation (x_1), and the reciprocal of peel moisture as percentage of dry peel (x_2) is very high ($R = +0.9898$).

It therefore appears that climatic conditions such as prevailing mean daily air temperatures and evaporation probably induce the same types of morphological responses in fruit as they do in leaves, the leaves probably playing a strong role by withdrawing water from the fruit in periods of water stress as has been long known in citrus.

Differences between mean maximum and mean minimum daily temperatures for the different districts appear not to be the major influence on these responses, because (i) the difference was smaller in the desert district than in any but the coastal district, and (ii) in all districts fruit from the tops of trees where they would be subjected to greater water stress had significantly greater peel puncture-pressures and higher dry weights per unit volume of peel, and lower percentage of moisture, than fruit from the lower regions of the trees.

S. P. Monselise
F. M. Turrell
Hebrew University, Rehovot, Israel, and *University of California Citrus Experiment Station, Riverside*

References and Notes

1. N. A. Maximov, *The Plant in Relation to Water*, R. H. Yapp, Trans. (Allen and Unwin, London, 1929).
2. D. Ebeling and L. J. Klotz, *Calif. Dept. Agr. Monthly Bull.* 35, 360 (1936).
3. R. J. Smith, *Report to Lemon Administration Committee* (mimeographed) (Dept. Agr. Econ., Univ. of California, Los Angeles, 1953).
4. Data from U.S. Weather Bureau, *Climatological Data, California section* (1949–1955), pp. 53–59.

15 September 1958

Rapid Diagnosis of Herpes Simplex Virus Infections with Fluorescent Antibody

Abstract. A fluorescent microscopy technique is described which may prove useful in differentiating clinically similar lesions into lesions of herpes simplex virus etiology and nonherpetic lesions. Herpes simplex virus was isolated from the specimens which yielded positive fluorescence, and no virus was isolated from the specimens which yielded no fluorescence.

The laboratory diagnosis of a herpes simplex virus infection is dependent upon the isolation and identification of the virus, the observation of type A inclusion bodies, or the demonstration of a rise in specific antibodies, or upon a

combination of these methods. Because of the time required for the completion of such tests, a diagnosis is made usually in retrospect. This same problem is encountered in the laboratory diagnosis of other viral diseases.

Liu (*1*) used the fluorescent antibody technique of Coons and Kaplan (*2*) in the rapid diagnosis of influenza. He observed specific fluorescence when nasal washings were treated with fluorescein-tagged influenza antiserum. Since fluorescence microscopy has been used to demonstrate herpes simplex virus in infected cells and tissues (*3*), its possible use in the rapid diagnosis of herpes simplex virus infections was the object of the preliminary investigation discussed in this report (*4*).

Microscopic slides were prepared from portions of specimens of scrapings from the base of vesicular lesions, from a spinal fluid, or from a nasal swab. These preparations were then fixed in acetone for 10 minutes, washed in physiological saline, and stained with fluorescein-labeled antiserum, which was produced in rabbits in response to subcutaneous injections of herpes-simplex-virus infected extraembryonic fluids of the developing chick embryo. This serum was absorbed with dried mouse-liver powder to remove nonspecific fluorescing material. The conjugation of the antiserum with fluorescein isocyanate and the staining of prepared slides were accomplished according to the method of Coons and Kaplan (*2*). The stained smears were examined with a Bausch and Lomb microscope fitted with a cardioid dark-field condenser and illuminated with a Reichert Fluorex HBO 200 mercury-arc vapor burner and filters.

Portions of the same specimens which were used for making smears were prepared in buffered gelatin saline containing antibiotics and were inoculated onto the chorioallantoic membrane of the developing chick embryo. Six embryos were used per specimen. After incubation of the embryos for 72 hours at 36°C, the chorioallantoic membranes were removed and examined for herpes simplex virus lesions.

Specific yellow or yellow-green fluorescence was observed with eight of the 15 specimens when the fluorescein-stained smears were observed by fluorescence microscopy. In Table 1 it can be seen that typical herpetic lesions were observed on chorioallantoic membrane inoculated with the same eight specimens in which specific fluorescence was observed. No specific fluorescence or herpetic lesions were observed with the other seven specimens. These results demonstrate good correlation with the tentative clinical diagnosis.

The results reported here give evidence that this technique may prove valuable in the diagnosis of vesicular lesions caused by herpes simplex virus. Whether this technique can be applied to spinal-fluid specimens in the diagnosis of herpetic aseptic meningitis or encephalitis is still not known. Establishment of the validity of this method could reduce the time required at present for viral diagnosis and may prove to be invaluable to the dermatologists in differentiation of lesions of herpes simplex virus from those caused by other agents.

JOSEPH Z. BIEGELEISEN, JR.
L. VERNON SCOTT
VESTER LEWIS, JR.

Department of Microbiology, University of Oklahoma School of Medicine, Oklahoma City

Table 1. Rapid diagnosis of herpes simplex virus infections by means of fluorescent antibody studies.

Patient	Tentative clinical diagnosis	Viral isolation		Fluorescence microscopy	
		Specimen	Results	Specimen	Results
B.	Generalized herpes simplex or vaccinia infection	Vesicular fluid	+	Vesicle lesion scraping	+
B. B.	Generalized herpes simplex or vaccinia infection	Vesicular fluid	+	Vesicle lesion scraping	+
Br.	Pemphigus	Vesicular fluid	−	Vesicle lesion scraping	−
E.	Aseptic meningitis	Spinal fluid	−	Spinal fluid	−
G.	Acute herpetic gingivostomatitis and rhinitis	Nasal washing	+	Nasal smear	+
N.	Shingles	Vesicular fluid	−	Vesicle lesion scraping	−
S.	Recurrent herpes of lip	Vesicular fluid	+	Vesicle lesion scraping	+
Pa.	Shingles complicating terminal leukemia	Vesicular fluid	−	Vesicle lesion scraping	−
Ph.	Herpes vulvovaginitis	Vesicular fluid	+	Vesicle lesion scraping	+
L.	Recurrent dermatitis	Vesicular fluid	−	Vesicle lesion scraping	−
Q.	Recurrent herpes of lip	Vesicular fluid	+	Vesicle lesion scraping	+
Sm.	Generalized dermatopaphism	Vesicular fluid	−	Vesicle lesion scraping	−
Sc.	Acute herpetic gingivostomatitis	Vesicular fluid	+	Vesicle lesion scraping	+
U.	Lesions on lips and pharynx	Vesicular fluid	−	Vesicle lesion scraping	−
M. S.	Recurrent skin eruptions	Vesicular fluid	+	Vesicle lesion scraping	+

References and Notes

1. C. Liu, *Proc. Soc. Exptl. Biol. Med.* 92, 883 (1956).
2. A. H. Coons and M. H. Kaplan, *J. Exptl. Med.* 91, 1 (1950).
3. J. F. O'Dea and J. K. Dineen, *J. Gen. Microbiol.* 17, 19 (1957); J. Lebrun, *Virology* 2, 496 (1956); J. Z. Biegeleisen, Jr., L. V. Scott, W. M. Joel, in preparation.
4. We wish to express our appreciation to the department of dermatology of the University of Oklahoma School of Medicine for its cooperation in this project. This work was supported in part by a grant (B964C2) from the National Institutes of Neurological Diseases and Blindness.

18 September 1958

Fluorescence of Tryptophan Derivatives in Trifluoroacetic Acid

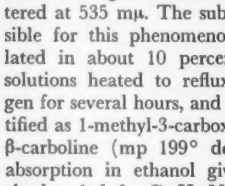
Abstract. Solutions of tryptophan-containing proteins in trifluoroacetic acid (TFA) develop green fluorescence. Studies have been made of the effect of TFA on tryptophan and tryptophan derivatives, and a dihydro-β-carboline has been identified among the fluorescent products.

Proteins and polypeptides are readily soluble in trifluoroacetic acid (*1*). Such solutions are useful for the investigation of the physical and chemical properties of proteins, and it is thus important to understand the extent of chemical degradation brought about by the strongly acidic solvent. This report deals with the effect of TFA on tryptophan-containing materials.

Solutions of tryptophan-containing proteins in TFA, even in the absence of oxygen, gradually develop a green fluorescence. This fluorescence is associated with the protein and is carried with it

on high-speed centrifugation of the solutions. Ovalbumin and lysozyme, for example, develop fluorescence of intensity roughly proportional to their tryptophan content [1 percent (*2*) and 5 to 6 percent (*3*), respectively]. This fluorescence is characterized by a single band having a peak at 530 ± 5 mμ (corrected for detector sensitivity), about 90 mμ wide at half-maximum intensity. Maximum fluorescent lifetimes were determined by flash irradiation and shown to be less than 2×10^{-7} second. The simple derivatives, glycyl tryptophan and acetyl tryptophan, develop fluorescence in the same fashion as the proteins.

The action of TFA on acetyl-DL-tryptophan was studied in detail. Storage of this substance in oxygen-free TFA results in the growth of a 365-mμ absorption band. Absorption of energy near this wavelength excites fluorescence centered at 535 mμ. The substance responsible for this phenomenon can be isolated in about 10 percent yield from solutions heated to reflux under nitrogen for several hours, and has been identified as 1-methyl-3-carboxy-3,4-dihydro-β-carboline (mp 199° dec.; ultraviolet absorption in ethanol given in Fig 1; *Anal.*, calcd, for $C_{13}H_{12}N_2O_2$: C, 68.41; H, 5.30; N, 12.27; Found: C, 68.13; H, 5.44; N, 12.19.) Although the isolated yield of carboline is poor, it is interesting to note that trifluoroacetic acid can bring about a cyclization reaction of the Bischler-Napieralski type. The low yield is in part accounted for by a transamidation (*4*).



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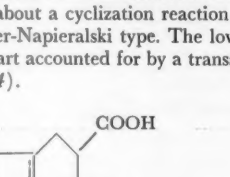

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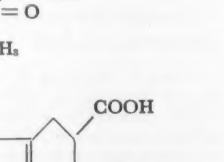


III

As might be expected, treatment of acetyl-DL-phenylalanine with TFA did not yield detectable quantities of the corresponding dihydroisoquinoline.

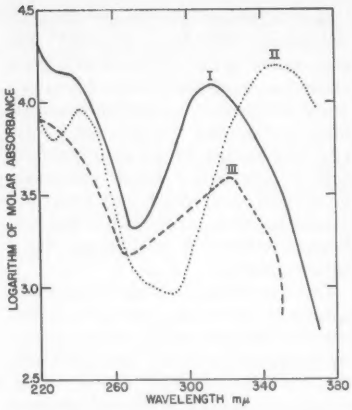


Fig. 1. Ultraviolet absorption spectra in ethanol: I, 1-methyl-3-carboxy-3,4-dihydro-β-carboline, alkaline solution; II, same as I, neutral or acid solution; III, fluorescent product isolated from TFA-treated glycyl tryptophan.

In studies of the fluorescence of the dihydro-β-carboline (II) in TFA solution, it was observed that the green fluorescence was gradually replaced by a blue (470 mμ) emission, with the development of an absorption maximum at about 280 mμ. This same change occurs in 6*N* hydrochloric acid solution and is found to be the result of an oxygen-requiring photodehydrogenation. The product of this oxidation is a mixture of 1-methyl-3-carboxy-β-carboline (III), dec. above 300° (ultraviolet absorption in acidic ethanol: $\lambda_{max.}$ 244, 277, 300, 365 mμ, log ε 4.48, 4.77, 4.21, 4.07. *Anal.*, calcd, for $C_{13}H_{10}N_2O_2 \cdot H_2O$, C, 63.92; H, 4.95; Found: C, 64.29; H, 4.97) and 1-methyl-β-carboline, mp 236°–238° dec. (*5*), identified by spectrum and melting point. Although, judged spectroscopically, the dehydrogenation reaction proceeds without side reactions, only 25 percent of III and 15 percent of the decarboxylated product were recovered in crystalline form.

The 530-mμ fluorescence which develops in oxygen-free TFA solutions of glycyl tryptophan, lysozyme, and ovalbumin is produced by a molecular species which has an absorption maximum at 420 mμ when in TFA solution. (A like fluorescence develops in solutions of glycyl tryptophan in other perfluoro acids, in concentrated sulfuric or phosphoric acids, and in anhydrous hydrogen fluoride.) The fluorescent product from TFA-treated glycyl tryptophan has been purified by extraction into butanol, followed by paper chromatography, but it has not been obtained in crystalline form; it is ninhydrin-active and is readily oxidized in air to dark colored products. Trifluoroacetic acid solutions of this isolated material exhibit the 420-mμ absorption and green fluorescence of the original TFA solutions; solutions in ethanol have the absorption spectrum shown in Fig. 1, but the long-wavelength maximum at 322 mμ is only slightly shifted (to 317 mμ) on acidification, in contrast to the shift to 350 mμ which occurs with known dihydro-β-carbolines. It would be unwise to assign a dihydro-β-carboline structure to this product, the more so since the 420-mμ absorption in TFA is not readily explained in terms of such a structure. Work is continuing on its identification although it is obtained only in small amounts, the bulk of the glycyl tryptophan remaining unchanged on 3 days' storage in TFA.

Tryptophan itself is unstable in TFA when oxygen is present; even traces of oxygen cause such solutions rapidly to become pink, rendering the detection of green fluorescence impossible. In the absence of oxygen, a weak green fluorescence (525 mμ) is observed immediately on mixing; this emission does not increase with time and is perhaps a property of impurities initially present in the solute. Tauber has reported a green fluorescence of tryptophan-containing materials dissolved in perchloric acid (*6*). The present work indicates that this observation may also be made (fluorescence at 535 mμ) on solutions in 70 percent sulfuric acid. In the sulfuric acid solvent, when oxygen has been excluded, an initial green fluorescence grows in quickly but does not further increase with time. It is probably a fair assumption that the green fluorescence of tryptophan in these solvents is the result of oxidation, and, in spite of the coincidence in emission maxima, has not the same source as the fluorescence of glycyl tryptophan, ovalbumin, and lysozyme in TFA.

Reports have been made of the formation of visibly fluorescent photo-oxidation products on ultraviolet irradiation of aqueous tryptophan solutions. These are said to be derivatives of kynurenine (*7*). In TFA, however, kynurenine (*8*) shows no detectable visible fluorescence, and kynurenic acid (*8*) emits at 445 mμ (about 500 mμ in 70 percent sulfuric acid), so that neither is responsible for the green emission observed in our studies. Tryptophan itself has been shown to fluoresce in aqueous solution, but in the ultraviolet region (360 mμ) (*9*).

R. A. UPHAUS
L. I. GROSSWEINER
J. J. KATZ
Argonne National Laboratory, Lemont, Illinois

K. D. KOPPLE
Department of Chemistry, University of Chicago, Chicago, Illinois

References and Notes

1. J. J. Katz, *Nature* 174, 509 (1954).
2. H. Neurath and K. Bailey, *The Proteins* (Academic Press, New York, 1953), vol. IA, p. 217.
3. C. B. Anfinsen and R. R. Refield, *Advances in Protein Chemistry* (Academic Press, New York, 1956), vol. 9, p. 27.
4. A paper describing the transamidation is in preparation.
5. H. R. Snyder and F. X. Werber, *J. Am. Chem. Soc.* 72, 2962 (1950).
6. H. Tauber, *ibid.* 70, 2615 (1948).
7. A. R. Deschrider and M. Renard, *Bull. inst. agron. et sta. recherches Gembloux* 23, 269 (1955); Z. Yoshida and M. Kato, *J. Am. Chem. Soc.* 76, 311 (1957).
8. Kindly supplied by Dr. J. M. Price of the University of Wisconsin.
9. H. S. Sprince, G. R. Rowley, D. Jameson, *Science* 125, 442 (1957); D. E. Duggan and S. Udenfriend, *J. Biol. Chem.* 223, 313 (1956).

9 October 1958

Source and Possible Nature of the Odor Trail of Fire Ants

Abstract. Experimental evidence shows that the odor trail of the fire ant *Solenopsis saevissima* (Fr. Smith) is produced as a secretion of the accessory gland of the poison apparatus and released through the extruded sting. Preliminary studies suggest that this substance may be chemically allied to or even identical with the toxic principle of the venom.

Chemical trails laid down by worker ants are essential mechanisms in the organization of foraging and colony migration in many ant species. Yet only recently has much careful attention been paid to the topographic form of these trails, to their anatomical source, and to their chemical nature (*1, 2*). Chemical analyses conducted by Carthy show that in the formicine species *Lasius fuliginosus* (Latreille) the trail substance is a water-soluble anal emission containing uric acid, polysaccharides, and proteins (*2*). These data suggest that the bulk of the material is normal excretory and fecal matter rather than a special glandular secretion. But they do not exclude the possibility that special secretory products, serving as releasers of trail-following behavior, may be present in small amounts.

Now it is possible to show that in the myrmicine species *Solenopsis saevissima* (Fr. Smith) the essential trail substance is produced as a glandular secretion and is released through the sting. Workers of this species lay trails by dragging the tips of their abdomens over the ground with the stings fully extruded. To determine whether venom passed from the sting can induce trail following, a series of experiments was performed in which artificial trails of freshly extracted venom were drawn in the vicinity of foraging workers from a captive colony. In separate trials, venom was either collected directly on sharpened cork tips or (to reduce the possibility of contamination) collected by "milking" the ants with fine capillary tubes and then transferring the fluid to cork tips.

In preliminary tests, foraging workers could almost always be diverted to the artificial venom trails, although their response was generally weaker than it was to true trails laid in the same area by living minor workers. Under the experimental conditions described below, three such trails produced from venom collected directly on cork tips brought forth 6, 8, and 18 workers, respectively, the duration of the effect extending between 1 and 2.5 minutes. Numerous artificial trails made under the same conditions from the wall and contents of the principal gut divisions, as well as from crushed tissue and hemolymph of head, alitrunk, and abdomen (gaster), evoked various intensities of alarm, circling, antennal palpation, and even feeding (in the case of the crop contents), but no distinct trail following.

An attempt was next made to localize the source of the critical trail substance. Three organs are known to empty material through the sting or in its immediate vicinity: the hind-gut, the "true" poison glands (which are paired and empty their contents into the poison vesicle), and the accessory gland of the sting. In a series of experiments these organs were dissected out of freshly killed major and media workers, separated, doubly washed in insect Ringer's solution, and then crushed on separate cork tips to make artificial trails. All three organs were taken from each ant killed, and these were presented in varying sequences to eliminate possible bias in the results due to special sequential effects. As much uniformity as possible was obtained with respect to the number of foraging workers and their trophic "mood" by first allowing masses of workers to accumulate around a freshly killed meal worm (larva of *Tenebrio molitor*) pinned at the edge of the glass plate on which the trails were drawn. Under the particular conditions prevailing at the time of the experiments, a relatively stable concentration of 150 to 200 workers was reached within 10 minutes after the meal worm had been found by the first foraging worker. At this time a fringe of more or less idle workers milled in a tight group around the edge of the meal worm, and it was to these that the artificial trails were drawn.

The results, presented in Table 1, show clearly that the trail substance is concentrated in the accessory gland of the sting. The fact that both the hind-gut and the true poison glands (with vesicle) frequently gave quite negative results suggests that these structures do not normally contain any of the releaser substance at all, only picking it up by contamination during dissection. The relatively high variation in response to the accessory gland preparation may be explained, at least in part, by two irregularities difficult to control: variation in leakage of gland contents during dissection and variation in responsiveness of worker groups. It was noted that when several trials were made on the same day, responsiveness tended to decline progressively.

Table 1. Response of fire ant workers to artificial trails made from various abdominal organs of ten freshly killed workers. The positive responses recorded are those in which workers ran at least half the length of the artificial trails, or approximately 8 cm. The duration is the time interval from the first positive response observed to the last and is given to the nearest half minute.

No. of workers responding		Duration of group effect (min)	
Range	Mean ± standard error	Range	Mean
Hind-gut			
0–18	2.3 ± 1.7	0–1.5	0.4
Poison glands plus poison vesicle			
0–26	8.2 ± 2.8	0–4	1.4
Accessory gland			
31–164	107.5 ± 14.4	3.5–7	5.9

The foregoing results lead to the question: Does the accessory gland substance serve as both releaser and orientator, or is it only a releaser, with venom from the true poison glands functioning as the orienting agent in the trails? To solve this problem, the following experiment was devised. After the experimental conditions described previously had been arranged, an *accessory* gland preparation was drawn in a short sidewise stroke next to the peripheral group of ants, while simultaneously an artificial trail made from the *poison* glands (plus vesicle) was drawn outward from them. In each of five such trials, the ants showed intense excitement, spreading outward in random looping movements, and many new workers were attracted to the scene. But in only one case was the poison-gland trail followed, and then by the relatively small force of 20 workers, representing less than 30 percent of the outward-moving swarm of foragers.

It thus appears that the accessory gland secretion functions as both a releaser and an orientator of trail following. On the other hand, it was noted that occasionally when workers were following accessory-gland trails in large numbers they would also follow nearby old

poison-gland trails that had been ignored previously. The implication seems to be that workers will follow other odor leads if there is some "knowledge" that a true (accessory-gland) trail exists. It also follows that only a small amount of the accessory-gland secretion need be in a trail to induce trail following. In fact, the venom from the true poison glands may be serving as a diluent for the accessory-gland secretion, although there is at present no direct evidence to support such a hypothesis (*3*).

The artificial trails made from accessory-gland preparations provide supernormal stimuli that attract far more workers than normal trails laid under similar circumstances by single living workers. The chemical nature of the releaser substance has not yet been precisely determined. However, the following data may be considered suggestive. A petroleum ether extract of steam distillate of whole ants prepared by M. S. Blum and his associates (*4*) produced trail-following responses of nearly comparable magnitude to those produced by accessory-gland preparations when it was tested under the experimental conditions described above. The number of workers drawn out by contact with the distillate was at least equal to the number attracted by the accessory-gland preparations, but orientation along the trails was somewhat less consistent. Blum *et al.* have shown that the infrared spectra of the distillate and of whole venom contain the same carbonyl band. On the basis of preliminary investigations, these authors have suggested that the carbonyl band is exhibited by the toxic principle itself, and that this constituent is manufactured by the accessory gland (*5*). It remains to be proved that the toxic principle and the trail-following releaser are one and the same (*6*).

EDWARD O. WILSON
Biological Laboratories, Harvard University, Cambridge, Massachusetts

References and Notes

1. E. C. Macgregor, *Behaviour* 1, 267 (1948).
2. J. D. Carthy, *ibid.* 3, 304 (1951).
3. P. S. Callahan (as he notes in correspondence with M. S. Blum) has found that the poison glands can be closed off at the base of the poison vesicle by a pair of highly developed muscle bundles; hence it is possible for the accessory gland to release its products independently of the poison glands. The possibility that such an operation occurs during trail laying should be considered in future studies.
4. I am indebted to Dr. Blum for supplying me with the fire ant extract used in this study and for granting permission to use unpublished data pertaining to it.
5. M. S. Blum (personal communication). For a report on the nature of whole venom, see M. S. Blum, J. R. Walker, P. S. Callahan, A. F. Novak, *Science* 128, 306 (1958).
6. It is interesting to note the significant observation by G. W. K. Cavill and D. L. Ford [*Chem. & Ind. (London)* 1953, 351 (1953)] that workers of the dolichoderine species *Iridomyrmex detectus* (Fr. Smith) follow artificial odor trails made from the steam distillate of other *detectus* workers. These authors have identified the distillate as 2-methylhept-2-en-6-one.

7 October 1958

Redox Absorption Spectra from Single Pigment Cells of Squid

Abstract. Single pigment cells from the squid *Loligo forbesi* have been studied by microspectrophotometry. The absorption spectra obtained show characteristic changes on reduction and oxidation which are compatible with those found in ommochromes. The presence of melanoid substances, however, cannot be excluded.

In several cephalopods, such as *Sepia officinalis, Octopus vulgaris,* and *Eledone moschata,* and also in arthropods such as Crustacea and Arachnoidea, a peculiar group of pigments, the ommochromes, has been found (*1, 2*). One of the significant properties of most ommochromes is that there is a characteristic change in the absorption spectrum on oxidation and reduction, although a few ommochromes do not behave in this manner (*3*). Pigments closely related are the ommatins (*3, 4*) and insectorubin (*5*), the latter being found in locusts and other insects.

In contrast to other investigations reported in the literature, the studies presented in this report were carried out on single pigment cells in the cutis of a cephalopod, *Loligo forbesi*, caught in the North Sea. The tissue was fixed in 4-percent Formalin, and sections were rinsed for 2 hours and immersed for 24 hours in a (reducing) 0.05*M* solution of $Na_2S_2O_5$. Microspectrophotometric measurements were made by comparing substrate and blank at each wavelength. The single pigment cells were magnified about 150 times. The absorption spectrum obtained after reduction is shown in Fig. 1 (curve 1). A maximum is found between 525 and 540 mμ, representing, when compared with measurements by Schwinck (*2*), a slight shift toward the longer wavelengths. This shift may be due in part to light scattering (*6*) or fixation. After oxidation for 24 hours in 7-percent H_2O_2, the maximum at 525 to 540 mμ essentially disappears (Fig. 1, curve 2).

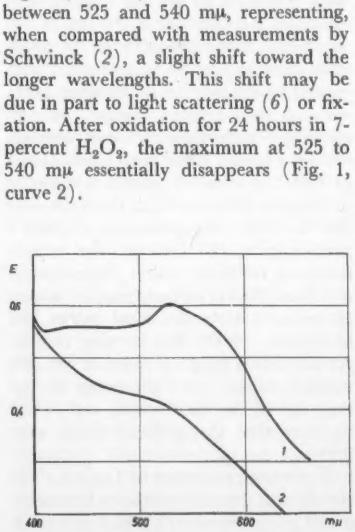


Fig. 1. Absorption spectra of a single pigment cell of *Loligo forbesi* after reduction (curve 1) and oxidation (curve 2) for 24 hours.

These results are in general agreement with bulk analyses on ommochromes reported by Becker (*1*) and Schwinck (*2*). They do not exclude, however, the presence of melanin or melanoid substances which show a gradually increasing absorption to the shorter-wavelength range (*7*); nor should it be postulated that the pigment found is identical with others already known. This study may merely show that, with suitable technique, redox absorption spectra can be obtained even from a single pigment cell and, thus, compared with analyses on extracted material.

MANFRED BAYER
Reinbek, Hamburg, Germany
JURGEN MEYER-ARENDT
Department of Pathology, Ohio State University, Columbus

References and Notes

1. E. Becker, *Naturwissenschaften* 29, 237 (1941).
2. I. Schwinck, *ibid.* 40, 365 (1953).
3. A. Butenandt and R. Beckmann, *Z. physiol. Chem., Hoppe-Seyler's* 301, 115 (1955).
4. A. Butenandt and G. Neubert, *ibid.* 301, 109 (1955).
5. T. W. Goodwin and S. Srisukh, *Biochem. J.* 47, 549 (1950).
6. P. Latimer, *Science* 127, 29 (1958).
7. E. Santamarina, *Can. J. Biochem. and Physiol.* 36, 227 (1958).

17 October 1958

Blood Groupings in Marshallese

Abstract. The absence of the Diego blood factor, the extremely low incidence of the *M* gene, and the unusually high R^1 gene frequency of the Marshallese more nearly resemble the blood groupings of the people of the western islands of Indonesia than the blood groupings of the Amerindians.

During March 1958, the annual medical survey of the Marshallese people of Rongelap Island was carried out, 4 years after they were accidentally exposed to radioactive fallout (March 1954) (*1*). These annual surveys are carried out by Brookhaven National Laboratory under the direction of R. A. Conard and are sponsored by the Atomic Energy Commission with the collaboration of the Department of Defense. During the course of these studies it became of interest to determine the blood groupings in the Marshallese people as an index of their origin and homogeneity. Blood samples were obtained by the survey team for this purpose.

The frequent movement of the Marshallese people among the various islands of Micronesia and, to a lesser extent, of Melanesia and other adjacent areas precludes any such concept as "pure" Marshallese. However, these people have lived for an estimated 2000 years on these islands with fewer outside contacts, perhaps, than most other groups. The findings presented consist of the

Table 1. Results of blood grouping of 129 Marshallese.

Group	No.	Percentage	Gene frequency*
ABO system			
O	75	58.1	.762 (r_o = .789)
A_1	24	18.6	.114 (p_o = .116)
A_2	0	0	
B	19	15.0	.093 (q_o = .095)
A_1B	10	7.4	
A_2B	1	0.8	
M-N system			
M	8	6.2	.14
MN	20	15.5	
N	101	78.3	.86
Rh-Hr system			
Rh_1Rh_1	126	97.7	.985
Rh_1rh	3	2.3	

* r_o, p_o, and q_o = corrected gene frequency for genes *O*, *A*, and *B*.

Table 2. Blood group frequencies among Marshallese and Polynesians.

Item	Marshallese		Polynesians
	This report (N = 129)	Simmons' report (4) (N = 678)	Simmons and Graydon's report (6) (N = 138)
ABO system			
Group (%)			
O	58.1	52.2	39.1
A	18.6	21.4	60.9
B	15.0	21.1	0
AB	8.2	5.3	0
Gene frequency			
r_o	.789	.723	.626
p_o	.116	.135	.374
q_o	.095	.134	0
Rh-Hr system			
Phenotype (%)			
Rh_1Rh_1	97.7	90.6	19.6
Rh_1rh	2.3	.7	.7
Rh_2	0	.3	29.7
Rh_1Rh_2	0	8.0	50.0
Gene frequency			
R^1	.985	.951	.449
R^2	0	.04	.543
R^0	.015	.006	.007
M-N system			
Type (%)			
M	6.2	10*	19.6
MN	15.5	19*	47.8
N	78.3	71*	32.6
Gene frequency			
m	.14	.22	.435
n	.86	.78	.565
Duffy system			
Fy^a + (%)	89.2	100	74.6
Kell system			
K + (%)	0		0
Diego system			
Di^a + (%)	0		0

* These values were calculated from published data.

blood groupings and gene distribution of 129 Marshallese and cannot be considered as characteristic of any special group, but rather a sampling of the gene distribution in the area. The results, by the ABO, M-N, and Rh-Hr systems, are shown in Table 1 and are compared with the results of other studies in Table 2.

ABO system. In the ABO system the high frequency of the B group which almost equals that of the A group is in sharp contrast to the absence of B or AB among the Polynesians. An unusual finding was one Marshallese of group A_2B. This was verified by testing with several absorbed B antisera, as well as with the lectin from *Dolichos biflorans* (2). The total absence of A_2 genes in Eastern Asia, Australia, and Indonesia has been repeatedly noted (3). Inquiry into the family background of the single A_2B native failed to reveal any significant information to lead one to suspect admixture.

M-N system. The low frequency of the *M* gene has been noted in this area by many investigators (4). The frequencies obtained in this study are among the lowest encountered and are in sharp contrast to the figures obtained among the Polynesians.

Rh-Hr system. A most unusual distribution was noted in the Rh-Hr system. Tests were performed with anti **Rh_0**(D), **rh′**(C), **rh″**(E), **hr′**(c), and **hr″**(e) sera.

A completely different set of results from those reported for Polynesians was obtained. In particular, the latter were reported as being of group Rh_1Rh_2 in 50 percent of the persons tested, whereas not a single individual of this grouping was found among the Marshallese. The gene frequency of 98.5 percent for R^1 is the highest reported for any ethnic group. The complete absence of any rh negative persons in these and related series makes one suspect that the true genotype of the bloods giving a positive reaction with anti-**hr′**(c) serum is most probably R^1R^0. The occasional finding of an Rh_0 person by Simmons *et al.* (4) supports this interpretation. In the present series of 125 samples there were no bloods that reacted with **rh″** (E) antiserum.

Duffy system. In the Duffy system there were found 89.2 percent Duffy (Fy^a) positive bloods. A previous report of 100 percent Duffy (Fy^a) positive reactions (4) (performed on 30 specimens that had been stored for 16 months) indicates a need for verification and clarification.

Other systems. Kell tests were 100 percent negative, as was previously reported. Diego tests were 100 percent negative (5).

The failure to demonstrate the Diego factor in any of the studies conducted in this area of the world is noteworthy. To date its absence in Polynesians (6), Maoris (7), and now in Marshallese becomes a significant finding in view of its occurrence in Mongoloids, Eskimos, and Amerindians (8), to whom Heyerdahl (9) credits the population of Polynesia.

The present findings (12) indicate a rather homogenous population of the Marshall Islands with extremes of gene frequencies. With some reservations, because of the relatively small sample, the following facts are of interest in the blood groupings of the Marshallese: (i) the extremely high frequency of the *O* gene (78.9 per cent); (ii) the extremely low frequency of the *M* gene (14 percent); (iii) the highest incidence of the R^1 gene yet reported (98.5 percent); (iv) the presence of 10.8 percent of Duffy (Fy^a) negatives; (v) the absence of the Kell and Diego blood factors; (vi) a single example of A_2B.

The investigations of numerous authors, compiled and summarized by Mourant, relate these blood groupings most nearly to those found in Southeast Asia and Indonesia, where relatively frequent *B* genes, a high *N* frequency, and a similarly high frequency of the R^1 gene are found.

LEON N. SUSSMAN
Department of Laboratories,
Beth Israel Hospital, New York

LEO H. MEYER
South Nassau Communities Hospital,
Oceanside, New York

ROBERT A. CONARD
Medical Department,
Brookhaven National Laboratory,
Upton, New York

References and Notes

1. R. A. Conard, L. M. Meyer, W. Wollins, W. W. Sutow, J. S. Robertson, A. Lowery, H. C. Urshel, J. M. Barton, "Medical survey of Marshallese four years post exposure," in preparation.
2. W. C. Boyd and R. Shapleigh, *J. Lab. Clin. Med.* **44**, 235 (1954).
3. A. E. Mourant, *The Distribution of the Human Blood Groups* (Thomas, Springfield, Ill., 1954), p. 123; L. N. Sussman, *Am. J. Clin. Pathol.* **26**, 471 (1956).
4. R. T. Simmons, J. J. Graydon, N. M. Semple, J. B. Birdsell, J. D. Milbourne, J. R. Lee, *Am. J. Physical Anthropol.* **10**, 31 (1953).
5. We are indebted to Dr. Philip Levine, who supplied the anti-Di^a serum, and to Dr. Miguel Layrisse, who supplied the Di^a-positive cells for control.
6. R. T. Simmons and J. J. Graydon, *Am. J. Physical Anthropol.* **15**, 357 (1957).
7. H. Lehmann, A. North, J. M. Staveley, *Nature* **181**, 791 (1958).
8. P. Levine, M. Layrisse, E. A. Robinson, T. Arends, R. D. Sisco, *ibid.* **177**, 40 (1956); M. Layrisse and T. Arends, *ibid.* **177**, 1083 (1956); M. Lewis, H. Ayukawa, B. Chown, P. Levine, *ibid.* **177**, 1084 (1956).
9. T. Heyerdahl, *American Indians in the Pacific: The Theory Behind the Kon-Tiki Expedition* (Allen and Unwin, London, 1952), p. 821.
10. We acknowledge the technical assistance of Hannah Pretshold.

5 August 1958

Meetings

Program of the Gordon Research Conferences

The Gordon Research Conferences for 1959 will be held from 15 June to 4 September at Colby Junior College, New London, N.H.; New Hampton School, New Hampton, N.H.; and Kimball Union Academy, Meriden, N.H.

Purpose. The conferences were established to stimulate research in universities, research foundations, and industrial laboratories. This purpose is achieved by an informal type of meeting consisting of scheduled lectures and discussion groups. Sufficient time is available to stimulate informal discussions among the members of each conference. Meetings are held in the morning and in the evening, Monday through Friday, with the exception of Friday evening. The afternoons are available for recreation, reading, or participation in discussion groups, as the individual desires. This type of meeting is a valuable means of disseminating information and ideas to an extent that could not be achieved through the usual channels of publication and presentation at scientific meetings. In addition, scientists in related fields become acquainted, and valuable associations are formed that often result in collaboration and cooperative efforts between different laboratories.

It is hoped that each conference will extend the frontiers of science by fostering a free and informal exchange of ideas among persons actively interested in the subjects under discussion. The primary purpose of the program is not to review the known fields of chemistry and physics but to bring experts up to date on the latest developments, to analyze the significance of these developments, and to provoke suggestions concerning the underlying theories and profitable methods of approach for making progress

In order to protect individual rights and to promote discussion, it is an established requirement of each conference that no part of the information presented is to be used without specific authorization of the individual making the contribution, whether in formal presentation or in discussion. Scientific publications are not prepared as emanating from the conferences.

Registration and reservations. Attendance at the conferences is by application. Individuals interested in attending the conferences are requested to send their applications to the director at least 2 months prior to the date of the conference. *All applications must be submitted on the standard application form, which may be obtained by writing to the office of the director.* This procedure is important because certain specific information is required in order that a fair and equitable decision on the application may be made. Attendance at each conference is limited to approximately 100.

The director will submit the names of those requesting authorization to attend to the Conference Committee for each conference. This committee will review the names and select the members in an effort to distribute the attendance as widely as possible among the various institutions and laboratories represented. A registration card will be mailed as soon as possible to those selected. Advance registration by mail for each conference is required, and registration is completed on receipt of the card and a deposit of $15. (Checks are to be made payable to the Gordon Research Conferences.) The deposit of $15 will be credited against the fixed fee for the conference if the individual attends the conference for which he has applied. A registration card not accompanied by the $15 deposit will not be accepted.

The Board of Trustees of the conferences has established a fixed fee of $100 for attendance at each conference. This fee was established to encourage attendance for the entire conference and to increase the special fund that is available to each conference chairman for the purpose of assisting conferees who attend a conference at total or partial personal expense with their travel or subsistence expenses, or with both. This fixed fee will be charged regardless of the time a conferee attends the conference—that is, for periods of from 1 to 4½ days. It is divided as follows: registration fee, $40 ($15 for administration and $25 for the special fund); room and meals, $60 (including gratuities) for 5 days. An additional charge of $1 per night per person will be made for a room with private bath or for a single room, of which there are only a limited number available. These rooms will be assigned in the order that applications are received.

Members attending a conference are expected to live at the conference location because one of the objectives of the conferences is to provide a place where scientists can get together informally for discussion of scientific research of mutual interest. It is to the advantage of all participants to attend a conference for the entire week. If special circumstances warrant living elsewhere, a registration fee of $50 is charged.

The fixed fee will cover registration, room (except room with private bath or single room), meals, and gratuities. It will not provide for golf, telephone, taxi, laundry, conference photograph, or any other personal expenses.

Conferees living at the conference location who will pay all or part of the fixed fee as a personal expense may request a reduction of $25 (the amount allotted for the special fund) in the fixed fee. Application for this special fee ($75) must be made when the registration card is returned to the director.

Accommodations are available for a limited number of women to attend each conference, and also for wives who wish to accompany their husbands. All such requests should be made at the time the attendance application is submitted because these accommodations, limited in number, will be assigned in the order that specific requests are received. Children under 12 years of age cannot be accommodated. Dogs and other animals will not be permitted in the dormitories.

Special fund. A special fund is provided for by the Board of Trustees from the registration fee and is made available to the chairman of each conference for the purpose of assisting scientists who could not otherwise attend or participate because of financial limitations. This fund is provided with the object of increasing the participation of research workers. Its use is not limited to scientists who have been invited by the chairman to attend a conference in order to present a paper. The money is to be used as an assistance fund only and may be used to contribute toward traveling expenses or subsistence expenses at the conference, or both. Total travel and subsistence expenses will not usually be provided.

Cancellations. The cancellation of an approved application for attendance at a conference will cause forfeiture of the $15 deposit.

Attendance. Requests for attendance at the conferences, or for additional information, should be addressed to W. George Parks, Director, Department of Chemistry, University of Rhode Island, Kingston, R.I. From 15 June to 4 September 1959 mail should be addressed to Colby Junior College, New London, N.H.

Colby Junior College

Separation and Purification

Edmond S. Perry, *chairman*
John E. Powers, *vice chairman*

15 June. John R. Bowman, "Separation of a continuum of components"; Lockhart B. Rogers, "Analytical separations and the Tower of Babel"; Maurice L. Huggins, "Separations in polymer systems."

16 June. Carl H. Deal, "Activity coefficients from gas chromatography measurements"; Julian F. Johnson, "Applications of novel gas chromatographic methods"; Harold H. Strain, "Electrochromatography—new modifications and applications."

17 June. Harry P. Gregor, "Membrane separation and purification processes"; Gerold Schwarzenbach, "Specific behavior of metals in complex formation."

18 June. William G. Pfann, "Recent developments in zone refining"; Kenneth B. McAfee, "Atomic interactions in barrier separations"; Paul G. LeFevre, "Permeation through animal cell membranes."

19 June. Luther E. Preuss, "Vacuum distillation and the radioactive tracer technique"; Theodore J. Williams, "Instrumentation and automatic control of the distillation process."

Petroleum

George H. Denison, *chairman*
Cheves Walling, *vice chairman*

22 June. J. R. Thomas, "Sonic degradation of high polymers in solution"; G. S. Hammond, "Some chemistry of oil-soluble chelates."

23 June. J. H. Schulman, "Influence of selective adsorption of amphipathic molecules on the bulk properties of solids"; Turner Alfrey, "Visco-elastic properties of polymer solutions."

24 June. M. Carmack, "Chemistry of 1,2,5-thiadiazole and related compounds"; F. M. Fowkes, "Polymeric detergents in oil."

25 June. S. A. Troelstra, "Stability of lyophobic colloids in hydrocarbons"; J. H. Schulman, "Static and dynamic control of contact angle."

26 June. H. H. Horowitz, "Bearing performance and elastic properties of polymer-thickened lubricating oil."

Catalysis

R. P. Eischens, *chairman*
Herman Pines, *vice chairman*

29 June. R. L. Burwell, Jr., "Reactions of hydrocarbons with hydrogen and deuterium on chromium oxide catalysts"; A. C. Zettlemoyer, "Acid sites."

30 June. R. J. Kokes and P. H. Emmett, "The structure of Raney nickel catalysts and their activity for ethylene hydrogenation"; P. W. Selwood, "Magnetization and chemisorption."

Qualified scientists are invited to submit applications for attendance at the Gordon Research Conferences. Application blanks may be obtained by returning the coupon that appears on page 654 to Dr. W. George Parks, Department of Chemistry, University of Rhode Island, Kingston, R.I.

1 July. P. H. Emmett, "Recent tracer studies on the mechanism of the Fischer-Tropsch synthesis"; D. S. Breslow, "Polymerization of ethylene with homogeneous catalysts."

2 July. G. L. Young, "Chemisorption studies from fuel cell potentials"; A. N. Webb, "Oxygen adsorption on supported platinum"; J. R. Tomlinson and D. E. O'Reilly, "Magnetic and optical studies of transition metal oxide catalysts."

3 July. R. H. Lindquist, "The nature of chromia-alumina catalysts."

Polymers

F. R. Eirich, *chairman*
E. M. Fettes, *vice chairman*

6 July. New polymers: H. F. Mark, "New developments in the field of high polymers"; L. W. Butz, A. M. Lovelace, J. C. Montermoso, "Research into extreme-performance polymers"; P. Goodman, "Pyroceram"; F. P. Caserio, "Linear phosphinoborine polymers"; W. F. Busse and W. C. Fernelius, *discussion leaders.*

7 July. Free radicals: C. Walling, "Recent developments in free-radical chemistry"; A. D. Jenkins, "Patterns of free-radical reactivity"; L. A. Errede, "Solution polymerization of *p*-xylene"; M. Szwarc and W. E. Cass, *discussion leaders.*

8 July. Ionic polymerization: A. V. Topchiev, "Stereospecific polymerization of α-olefins"; A. Nasini, "Polymers from diazoalkanes: mechanisms and stereospecificity"; C. E. H. Bawn, "Polymerization of diazo compounds with boron catalysts"; D. L. Glusker, "Mechanism of the anionic polymerization of methyl methacrylate"; D. Pepper and C. G. Overberger, *discussion leaders.*

9 July. Solid state: H. A. Stuart, "The para crystalline structure of high polymers"; J. D. Hoffman, "Dielectric absorption in semicrystalline polymers"; F. Price, "The nature of the spherulites in polyethylene"; J. J. Hermans and J. H. Gibbs, *discussion leaders.*

10 July. Structure and behavior: E. F. Gurnee, "Optical studies of amorphous polymers"; H. W. McCormick, "The effect of molecular weight distribution on the mechanical properties of polystyrene"; T. Smith, "The ultimate properties of amorphous polymers"; A. Bueche, *discussion leader.*

Textiles

Leonard Smith, *chairman*
Fred Fortess, *vice chairman*

13 July. Harold P. Lundgren, "New findings in wool structure, stability, and modification"; Sheldon Sprague, "The relationship of polymer constitution and fiber fine structure to fiber physical properties."

14 July. V. W. Tripp and Fred Perkerson, "Phenomena associated with cross-linking of cotton cellulose"; Richard Steele and John L. Gardon, "Chemical control of crease recovery and wash-wear effects in cellulose fibers."

15 July. E. L. Wittbecker, "Interfacial polycondensation"; E. E. Magat, "Interfacial spinning"; E. V. Martin, "Kodel polyester fibers."

16 July. Joel Lindberg, "The measurement of mechanical properties and prediction of fabric performance"; DeWitt R. Petterson and Stanley Backer, "On the mechanics of nonwovens."

17 July. Jack C. Smith, "Stress-strain relations in yarns subjected to high-speed impact."

Corrosion

Philip M. Aziz, *chairman*
Milton Stern, *vice chairman*

20 July. The nature of metal surfaces as revealed by friction and wear measurements (H. A. Liebhafsky, *moderator*): E. H. Freitag, "Modern methods of studying the structure of solid surfaces"; A. J. Haltner, "Solid lubricants"; L. E. St. Pierre, "Reactions at metal surfaces"; E. H. Freitag, "The friction and deformation of metallic surfaces."

21 July. Kinetics of oxidation processes (J. E. Draley, *moderator*): F. W. Young, "Oxide nuclei and dislocations"; M. Cohen, "The oxidation of iron at low temperatures"; A. J. Rosenberg, "Oxidation of intermetallic compounds"; R. K. Hart, "Investigation of metals in aqueous environments with particular reference to aluminum."

22 July. Kinetics of electrode processes (M. Stern, *moderator*): B. E. Conway, "Corrosion of the nickel–nickel oxide electrode; kinetics and mechanism of self-discharge and oxygen evolution"; J. O'M. Bockris, "The mechanism of the dissolution of metals"; D. A. Vermilyea, "The role of crystal defects in corrosion processes."

23 July. Inhibition of corrosion reactions (N. Hackerman, *moderator*): A. C. Makrides, "The inhibition of metal dissolution"; M. Stern, "The effect of metal alloying on inhibition processes"; J. E. O. Mayne, "The inhibition of the corrosion of iron in neutral and alkaline solutions"; E. A. Blomgren, "The ad-

sorption of aromatic amines on metal surfaces."

24 July. Inhibition of corrosion reactions (continued): general discussion of current theories of inhibition.

Organic Coatings

Donald F. Koenecke, *chairman*
S. Gusman, *cochairman*

27 July. C. E. Anagnostopoulos, "A statistical-thermodynamic treatment of polyvinyl chloride plasticizer compatability"; Valeria Artel, "Evaporation and diffusion characteristics of resin solvents."

28 July. J. E. O. Mayne, "The mechanism of the inhibition of the corrosion of iron particularly by paint"; J. P. Simko, "Studies on films under cathodic protection conditions."

29 July. B. D. Beitchman, "Studies of the mechanism of asphalt degradation during weathering"; M. E. Bailey, "Correlation of structure and coating properties of polyurethane copolymers."

30 July. J. F. Vitkuske, "Fundamental colloidal behavior of latexes"; M. C. Carpenter, "Practical application of latex fundamentals in the formulation and use of latex-based and other waterborne industrial paints."

31 July. H. Dannenberg, "Measurement of adhesion by a blister method."

Medicinal Chemistry

Alfred Burger, *chairman*
Irwin H. Slater, *vice chairman*

3 Aug. M. Nickerson, "Adrenergic mechanisms and hypertension"; R. P. Mull, "Chemistry of agents with protracted antihypertensive action which 'deform' the cardiovascular responsitivity to adrenergic and antiadrenergic substances"; R. A. Maxwell, "Pharmacology of compounds with central nervous and cardiovascular activity which 'deform' the cardiovascular responsitivity to adrenergic and antiadrenergic substances"; A. J. Plummer, "The hypotensive activity of various esters of methyl reserpate."

4 Aug. Chemotherapy of schistosomiasis: O. D. Standen, "Mode of action"; E. F. Elslager, "Structure activity"; H. Most, "Clinical status." *Thyroxin and its analogs*: R. I. Meltzer, "A survey of synthetic methods"; R. L. Kroc, "A survey of biological activities."

5 Aug. R. Boissonnas, "Preparation and testing of some new synthetic polypeptides"; C. H. Li, Eugen Schnabel, David Chung, "Synthetic peptides and their melanocyte-stimulating activities"; L. T. Skeggs, "Polypeptides of the renin-angiotensin system"; H. F. Hardman, "An analysis of the effect of *p*H and drug ionization on cardiac tissue."

6 Aug. M. Sidman, "Operant behavioral techniques"; P. B. Dews and W. Morse, "Schedule parameters as determinants of drug effects"; T. Verhave, "Behavioral analysis of methamphetamine"; I. M. Weiner, "Mechanism of mercurial diuresis."

7 Aug. J. T. Litchfield, "Sequential analysis, screening, and serendipity"; C. J. Klett, "A clinical comparison of five phenothiazines—statistical treatment"; Samuel Irwin, "General philosophy and methodology of screening: a multidimensional approach."

On the evenings of 5 and 6 August only one paper is scheduled. Additional short presentations will be arranged at the time of the conference. Participants who wish to present 15- to 20-minute papers can plan to speak on these evenings.

Elastomers

Paul G. Carpenter, *chairman*
R. L. Zapp, *vice chairman*

10 Aug. J. P. Buckley and M. Berber, "A new technique for measuring volume swell and its application to elastomer studies"; A. R. Kemp, "Solubility and viscosity characteristics of elastomers"; R. Norman, "Frictional properties of flexible vinyl polymers."

11 Aug. A. M. Gessler, "The attrition of carbon black: surface chemistry and reinforcing effects"; E. M. Dannenburg, "Properties of attrited carbon black"; E. R. Bartholomew, "Elastomers for high-temperature services."

12 Aug. R. D. Stichler, "Observations on tire performance"; A. D. Dingle *et al.*, "Resilience and power loss of elastomers"; speaker and subject to be announced.

13 Aug. C. F. Fryling, "Colloidal properties of synthetic latices"; speaker and subject to be announced; speaker and subject to be announced.

14 Aug. Oliver Burke and Eldon Stahley, "Vinylic filler reinforcement of elastomers."

Food and Nutrition

L. J. Teply, *chairman*
D. B. Hand, *vice chairman*

17 Aug. C. A. Baumann, *chairman*: John Yudkin, "Some vitamin-carbohydrate interrelationships"; D. C. Herting, "Nutritional aspects of saturated fats." E. E. Howe, *chairman*: M. Behar, "Clinical and practical aspects of protein malnutrition."

18 Aug. H. P. Broquist, *chairman*: W. J. Darby, "Human requirements for some of the 'lesser' B-vitamins"; J. Matovinovic, "Metabolism of nucleic acids in normal and pathological thyroid." R. A. Harte, *chairman*: Panel: Grace A. Goldsmith, F. J. Stare, W. A. Krehl, J. M. Brozek, "What is a normal, acceptable, or desirable state of nutrition."

19 Aug. Hartley Howard, *chairman*: P. L. Day, "Food standards and the public welfare"; P. L. White, "Nutrition education and nutritional advertising." R. H. Silber, *chairman*: R. E. Olson, "Metabolic functions of vitamin E and ubiquinone"; discussion: M. K. Horwitt.

20 Aug. A. E. Schaefer, *chairman*: H. Spector, "Relationship of food to radiation effects"; J. R. Couch, "Unidentified factors in chick nutrition." Z. I. Kertesz, *chairman*: A. G. van Veen, "Problems and possibilities in improving indigenous foods."

21 Aug. D. B. Hand, *chairman*: J. C. Bauernfeind, "Ascorbic acid in food technology"; F. W. Blodgett, "The future of pressurized food packages."

Instrumentation

Clifford E. Berry, *chairman*
Paul C. Hoell, *vice chairman*

24–28 Aug. Invited papers: J. Lloyd Bohn, "Instrumentation for use in satellite and rocket experiments"; Lawrence J. Fogel, "Linking man to high-speed machines"; David M. Gates, "High-altitude spectroscopy from balloons"; William Priestly, Jr., "Philosophy of design for an unattended computer-controlled process"; Paul E. Smith, Jr., "Instrumentation for industrial physiology"; Albert F. Welch, "Instrumentation in automotive research"; E. Hilburn, "Anamorphic motion picture display."

Contributed papers: J. H. Laub, "A study of externally pressurized gas bearings for instrumentation"; Sidney Lees, "New methods of measuring the wind"; R. H. Taplin, "Information extraction techniques for spectral analysis"; Ronald P. Schwenker, "Transistor demodulation at ultrasonic frequencies"; Raymond Jonnard, "A practical scheme for automatic clinical procedures"; E. Hilburn, "An *N*-dimensional cam"; Erik Blomgren, "New principles and devices for the study of electrochemical phenomena"; John J. Stansbrey, "New uses for microencapsulated materials"; W. Norris Tuttle, "New techniques for using semiconductor diodes in precision instruments"; C. S. Draper, "Dynamic support of instrument components by viscous fluids"; Phillip D. Schnelle, "Simplification of complex instrument functions"; Arthur E. MacNeill, "Therapeutic instrumentation for bedside use"; E. C. Lloyd, "A tilting air-lubricated piston gauge for pressures below 0.5″ Hg."

Cancer

Frederik B. Bang, *chairman*
Philippe Shubik, *vice chairman*

31 Aug. Epidemiology: J. Clemmesen, "Epidemiology of lung and bladder cancer"; A. Lilienfeld, "Epidemiology of breast cancer." *Virus aspects* (Frederick B. Bang, *chairman*): M. A. Epstein, "Electron microscopy; purification of Rous virus"; W. Bernhard, "Electron microscopy of tumors"; R. F. Buffett and H. Levinthal, "A survey of the

leukemia and related tumor viruses in mice."

1 Sept. Polyoma virus: S. Stewart, "Studies on the antigenicity of SE polyoma virus and its relationship to other viruses"; B. Eddy, "Studies on the latency of SE polyoma virus"; W. Rowe, "Studies on polyoma virus." *Comparative oncology* (H. Schlumberger, *chairman*): Armin C. Braun, "A physiological basis for the autonomous growth of three non-self-limiting neoplastic diseases of plants"; H. Ratcliffe, "Comparative aspects of spontaneous tumors."

2 Sept. Chemotherapy. A. Goldin and J. Venditti, "Quantitative evaluation of drugs in mouse tumors"; J. Sholer and Leon Schmidt, "Quantitative evaluation of drugs in rat tumors"; W. Kessler and R. Jones, Jr., "Quantitative evaluation of drugs in rat leukemia"; G. Zubrod, E. K. Marshall, Jr., P. Waalkes, "Quantitative evaluation of drugs in man and correlation with animal data." *Biochemistry* (P. Shubik, *chairman*): E. Racker, "Carbohydrate metabolism in tumors"; H. Garland, "Radiotherapy."

3 Sept. Deoxyribonucleic acid and tumors: R. M. Herriott, "Biological properties of nucleic acids"; A. Fjelde and P. Sorkin, "Production of mouse tumors by nucleic acid extracts"; U. Heine, "RNA extracts of Rous tumors." *Tissue relationships* (P. Grant, *chairman*): A. A. Moscona, "Cellular interactions in experimental histogenesis"; B. G. Boving, "Invasion mechanisms in placentation."

4 Sept. Immunology test: J. Makari, "Cancer detection by immunological methods," discussion led by A. Osler; K. Porter, "Electron microscopy of carcinogenesis."

New Hampton School

Chemistry and Physics of Liquids

B. H. Zimm, *chairman*
R. T. Beyer, *vice chairman*

15 June. J. E. Mayer, "Current status of the theory of liquids"; S. A. Rice, "Transport theory"; F. C. Collins, "Transport theory."

16 June. M. Fixman, "Acoustical model of momentum transport"; W. W. Wood, "Machine computations of equation of state"; T. Wainwright, "Machine computations of phase transitions"; H. Reiss, "Statistical mechanics of rigid spheres."

17 June. J. Ross, "Transport theory"; D. Turnbull, "Glass formation"; J. H. Gibbs, "Theory of glass formation."

18 June. G. H. Vineyard, "Neutron scattering and atomic motions in liquids"; B. N. Brockhouse, "Neutron scattering"; E. W. Hart, "Spatial correlation of fluctuations."

19 June. F. Stillinger, "Theory of fused salts"; B. Alder, "Studies of phase transitions by shocks."

Chemistry and Physics of Coal

Henry C. Howard, *chairman*
John Mackay, *vice chairman*

22 June. Functional groups in coal (E. F. Williams, *chairman*): P. H. Given; F. B. Brown and H. G. Davis; Sidney Friedman; L. Blom; H. Tschamler.

23 June. Low-temperature reduction reactions (Irving Wender, *chairman*): R. M. Elofson; P. H. Given. G. R. Yohe, *chairman*: Irving Wender. *Polymeric character of coal*: J. P. Fugassi and Ruth Trammell.

24 June. Optical and mass spectra (R. A. Friedel, *chairman*): H. Tschamler; A. G. Sharkey; H. W. Holden, R. S. Montgomery.

25 June. Structural methods in the study of coal and related products (R. A. Glenn, *chairman*): D. S. Montgomery. *Structure of carbonaceous materials related to coal*: C. R. Kinney. *Physicochemical methods in the study of coal structure* (Sabri Ergun, *chairman*): Louis Robert; J. T. McCartney; V. H. Tiensuu.

26 June. Round-table discussion and plans for 1960 conference (John Mackay, *chairman*).

Proteins and Nucleic Acids

Stanford Moore and Hans Neurath, *cochairmen*
R. L. Sinsheimer, *vice chairman*

29 June–3 July. The scope of research on proteins and nucleic acids is becoming so wide that it is proving necessary to focus attention on one or the other subject in alternate years of this conference. The meeting will be devoted primarily to discussion of the structural chemistry of proteins. Among the speakers and leaders of discussions will be: C. B. Anfinsen, Jr., E. H. Fischer, B. S. Hartley, C. H. W. Hirs, E. Katchalski, I. M. Klotz, C. H. Li, R. R. Porter, F. M. Richards, F. Sanger, R. Schwyzer, E. L. Smith, H. A. Sober, and P. Wilcox. The discussion, which forms a major portion of these conferences, will be open to the presentation of a wide variety of recent results bearing on the structure of protein molecules.

Magnetic Resonance

Clyde A. Hutchison, Jr., *chairman*
George E. Pake, *vice chairman*

6 July. High-resolution nuclear spectroscopy (H. M. McConnell, *chairman*): G. V. D. Tiers and P. L. Panson, "A study of proton shielding values, τ, for ferrocenes and related compounds: comparison with the benzene analogs"; A. A. Bothner-By, "Inter- and intramolecular shieldings in organic compounds." W. A. Anderson, *chairman*: R. E. Richards, "Coupling constants in various stereochemical configurations of organic compound." Recent developments in high-resolution spectroscopy, round-table discussion: P. Bender, J. C. Guffy. B. R. McGarvey.

7 July. Population readjustment phenomena, nuclear polarization, and double resonance (A. Abragam, *chairman*): G. E. Pake, "Nuclear polarization and resonance shifts in free radicals exhibiting electron exchange"; E. L. Hahn, "Pulsed nuclear double resonance"; N. Bloembergen, "Cross relaxation in spin systems." N. Bloembergen, *chairman*: G. Feher, "Nuclear orientation schemes in paramagnetics with resolved hyperfine interactions"; A. Abragam, "Dynamic polarization of Si^{29} in silicon."

8 July. Reaction rates and dissociation in solution (G. C. Hood, *chairman*): W. G. Schneider, "NMR studies of some nuclear exchange processes"; H. S. Gutowsky, "Proton exchange and molecular association in solutions"; J. Itoh, "NMR studies of aqueous solutions of alkali halides." *Electronic resonance in crystals* (H. S. Jarrett, *chairman*): H. M. McConnell, "Paramagnetic resonance of oriented radicals"; L. Helmholtz, "Paramagnetic resonance spectra of chromium and manganese hexafluoride ions and their electronic structure"; C. A. Hutchison, Jr., "Paramagnetism of phosphorescent naphthalene."

9 July. Molecular motion and nuclear resonance (W. P. Slichter, *chairman*): C. M. Huggins, "Structure and molecular motion in complex polymeric systems"; K. M. Sinnott, "Nuclear magnetic resonance and molecular motions in a series of acrylic polymers"; W. P. Slichter, "Hindered motion in solid polymers." *Chemical applications of nuclear resonance* (S. I. Weissman, *chairman*): B. Commoner, "Electron spin resonance studies of biochemical and biological systems"; S. I. Weissman, "Interactions between weakly coupled systems."

10 July. Electronic resonance in irradiated systems (W. Känzig, *chairman*): M. Matheson, "Electron spin resonance in irradiated rigid organic materials"; G. D. Watkins, "Paramagnetic resonance in electron irradiated silicon and germanium"; R. Livingston, "Electronic resonance in gamma-irradiated substances at low temperatures (recent atomic hydrogen and single crystal results)."

Organic Reactions and Processes

Robert I. Stirton, *chairman*
William J. Bailey, *chairman-elect*

13 July. R. I. Stirton, introductory remarks; Harold Zaugg, "Specific solvent effects in the alkylation of enolate anions —alkylation of sodiomalonic esters"; Herbert C. Brown, "Selective reductions."

14 July. Ernest L. Eliel, "Reductions with lithium aluminum hydride–aluminum chloride"; Oscar L. Wright, "Ion-exchange resins as reagents in organic

reactions"; Michael J. S. Dewar, "Aromatic rearrangements."

15 July. Fausto Ramirez, "New synthetic applications and mechanisms of reactions of esters of phosphorous acid"; S. A. Buckler, M. Grayson, M. M. Rauhut, V. P. Wystrach, "Studies in the formation of carbon-phosphorus bonds"; D. J. Hadley, "The production and uses of nitriles."

16 July. William E. Truce, "Stereospecific reactions of nucleophilic sulfur compounds with chloroethylenes and acetylenes"; Norman A. Rosenthal, "Mechanism of the alkali cleavage of alkyl disulfides"; Ellis K. Field, "Air oxidation of aromatics by a new liquid-phase process."

17 July. Calvin L. Stevens, "Epoxyethers."

Microbiological Deterioration

Charles C. Yeager, *chairman*
Lloyd R. Snoke, *vice chairman*

20 July. Marine microbiological deterioration (Lloyd R. Snoke, *chairman*): R. Y. Morita, "Microbial activity in the deep sea with reference to corrosion"; Douglas Marsland, "Pressure as a physiological factor in the deep-sea environment"; T. W. Johnson, Jr., "Ecology of marine and estuarine fungi"; R. A. MacLeod, "The nutrition and metabolism of marine bacteria."

21 July. Antibiotics for nonmedical use (Curt Leben, *chairman*): P. W. Brian, "Metabolic interrelations between soil microorganisms in relation to their saprophytic and plant-parasitic activities"; J. C. Lewis, "Antibiotics and the preservation of food"; S. H. Ross, "Antibiotics and the preservation of material"; Curt Leben, "Antibiotics and plant disease."

22 July. Cytological study of deterioration (Charles C. Yeager, *chairman*): Mary Mandels, "The induction of cellulase in fungi"; Blanche R. Porter, "Effect of cellulase on cotton fiber microstructure"; Donald D. Ritchie, "Reaction of fungus cells to some environmental variables"; A David Baskin, "Kinetics of deterioration"; Ellis Cowling, "Structural aspects of the deterioration of wood and natural fibers."

23 July. Physiology of spore formation and germination (Saul Rich, *chairman*); Alfred Sussman, "Germination of *Neurospora* ascospores"; Gabriel Mandels, "Germination of *Myrothecium* spores"; Vincent W. Cochrane, "Physiological differences between spores and mycelium"; Edward Cantino, "Physiology of spore formation in *Blastocladiella.*"

24 July. Physiology of spore formation and germination (continued) (Saul Rich, *chairman*): W. S. Nickerson, "Cellular division in yeast"; W. D. McClellan, "Effect of light on spore formation."

Radiation Chemistry

Warren M. Garrison, *chairman*
Max Matheson, *vice chairman*

27 July. R. L. Platzman, "Degradation spectra and their role in determining the abundance of various primary products"; R. W. Nicholls, "Spectroscopic study of luminosities produced by ionizing radiation in gases"; B. Brocklehurst, "Luminescence of gases irradiated with x-rays"; H. Kallman, "Study of energy transfer through fluorescence and phosphorescence."

28 July. P. S. Rudolph, "Mass spectra of organic ions produced by 5-Mev alpha particles"; F. W. Lampe, "Hydrogen atom reactions initiated by ionizing radiations"; W. A. Wilson, subject to be announced; J. E. Willard, "Phase, temperature, and scavenger effects in the radiation chemistry of organic halides"; W. H. Hamill, "Evidence for electron capture in irradiated organic-liquid mixtures."

29 July. T. J. Hardwick, "Radiolysis of hexane"; A. S. Newton, "Effects of electronegative groups in radiolysis"; H. A. Dewhurst, "Radiation chemistry of siloxanes"; J. H. Baxendale, "Radiation chemistry of methanol"; G. O. Schenck, Sensitization and constitution in photo- and radiation chemistry."

30 July. A. Chapiro, "Ionic chain reactions initiated by radiations"; A. Charlesby, "Ionic polymerization reactions"; H. Fricke, "Applications of electronic computers in the development of diffusion theory"; H. A. Schwarz, "Radical combination reactions in the radiolysis of water."

31 July. E. J. Hart, "Radiation chemistry of aqueous formic acid"; H. A. Mahlman, "Radiolysis of aqueous nitrate solutions."

Steroids and Related Natural Products

Gilbert Stork, *chairman*
E. J. Corey, *vice chairman*

3–7 Aug. E. J. Agnello, "Recent chemistry of cortiocosteroids"; D. Arigoni, subject to be announced; K. Bloch, "Studies of terpene biogenesis"; G. Büchi, "Aspects of alkaloid chemistry"; E. J. Corey, "Selective introduction of functional groups at a saturated, unactivated carbon atom"; M. J. Cron, "The chemistry of kanamycin"; A. Eschenmoser, subject to be announced; H. B. Henbest, "Directing effects in additions to unsaturated steroids"; H. H. Inhoffen, "Total synthesis of vitamin D_3"; H. G. Khorana, "Recent progress in the synthesis and structural analysis of polynucleotides"; W. S. Johnson, "Relative stabilities of boat and chair forms of cyclohexane ring systems"; S. M. Kupchan, "Chemistry of the hypotensive veratrum alkaloids"; J. Meinwald, "Elimination reactions of tropanes and related compounds"; G. Ourisson, "Ring-nor steroids"; S. W. Pelletier, "Certain aspects of the chemistry of the aconitum alkaloids"; R. B. Turner, "Structure and synthesis of cassaic acid"; E. E. van Tamelen, subject to be announced.

Inorganic Chemistry

R. W. Mason, *chairman*
C. P. Haber, *vice chairman*

10–11 Aug. Transition metal oxides (Ephraim Banks, *chairman*): A. Magnéle, "Ordered and disordered phases in some transition metal oxide systems"; R. Ward, "Some anion-deficient phases among the ternary oxides"; F. J. Morin, "Electronic energy bands in the transition metal oxides"; G. H. Jonker, subject to be announced; H. Hoekstra and S. Siegel, "Structural chemistry of the uranium-oxygen system"; H. J. Borchardt, "Mechanisms of reactions between some inorganic solids"; A. D. Wadsley, "A new series of structurally related oxide complexes of niobium"; speaker and subject to be announced.

12 Aug. Composition control in molecular engineering (Robert C. DeVries, *chairman*): D. H. Wilkins, "Preparation of pure inorganic materials using ion exchange techniques"; H. Samelson, "The growth of pure and doped ZnS crystals and effects of doping on some of their properties"; M. W. Shafer, "Composition control during growth and subsolidus changes in ferrite single crystals"; speaker and subject to be announced.

13–14 Aug. Properties of solids in relation to their structures (Seymour Geller, *chairman*): M. K. Wilkinson, "Magnetism"; J. M. Hastings and L. M. Corliss, "Magnetism"; J. H. Wernick and S. Geller, "Thermoelectricity"; J. C. R. Kelly, "Thermoelectricity"; B. T. Matthias, "Superconductivity"; J. K. Hulm, "Superconductivity."

Analytical Chemistry

John Mitchell, Jr., *chairman*
Charles N. Reilley, *vice chairman*

17 Aug. S. Dal Nogare, "Gas chromatography"; R. F. Goddu, "Near-infrared spectroscopy"; L. C. Jones, Jr., "Far-ultraviolet spectroscopy."

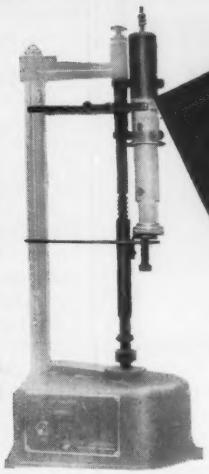
18 Aug. R. Belcher, "Elemental analysis"; F. E. Critchfield, "Functional group analysis."

19 Aug. L. Gierst, "Galvanostatic and potentiostatic methods." Discussion.

20 Aug. D. L. Wood, "Infrared spectroscopic methods for characterizing high polymers"; L. H. Phifer, "Decomposition of high polymers."

21 Aug. R. J. Keirs, "Fluorescence and phosphorescence."

new instruments for infusion and retracting of liquids



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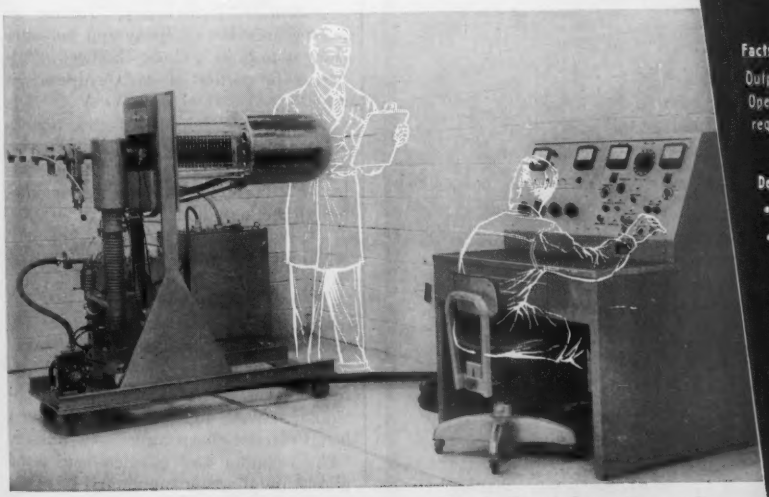

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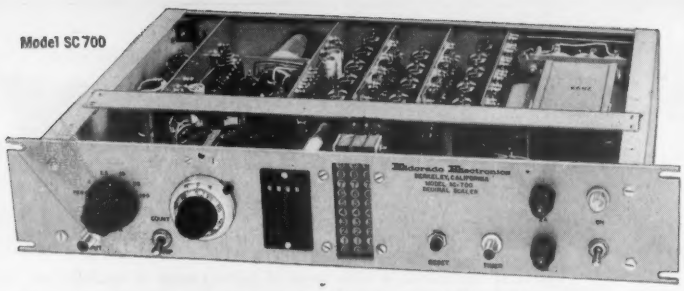

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Statistics in Chemistry and Chemical Engineering

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24 Aug. John C. Whitwell, *chairman*: Frank S. Riordan, Jr., "Evolutionary operations." Ralph A. Bradley, *chairman*: Hubert M. Hill, "Designs to compensate for trends in time."

25 Aug. Henry Scheffe, *chairman*: Otto Dykstra, Jr., "Partial duplication of factorials." Frank W. Wehrfritz, *chairman*: H. C. Hamaker, "On multiple-regression analysis."

26 Aug. Mavis B. Carroll, *chairman*: George E. P. Box, "Nonlinear estimation." Harry Smith, Jr., *chairman*: Gabriel Kron, "Multidimensional curve fitting with irregular polyhedrons."

27 Aug. Martin Wilk, *chairman*: James L. Dolby, "Random balance." S. Lee Crump, *chairman*: Carl A. Bennett, "Fixed, mixed, and random models."

28 Aug. Hale Sweeny, *chairman*: H. L. Lucas, "Change-over trials."

Adhesion

Alan A. Marra, *chairman*
Harold F. Wakefield, *vice chairman*

31 Aug. R. Oriani, "Surface behavior as affected by internal organization of solids"; B. G. Ranby, "Adhesion characteristics of cellulosic materials."

1 Sept. J. E. Rutzler, "Surface properties and types of bonds involved"; W. E. Holland and J. D. Haygood, "High temperature creep measurements as a means of estimating surface free-energy."

2 Sept. R. L. Patrick, C. A. Kumins, and M. Gottlieb, "Molecular interactions with the surfaces of solids"; R. R. Stromberg, "Adsorption of polymers."

3 Sept. F. J. McGarry, "Factors affecting adhesion of epoxy and polyester systems to glass"; C. G. Caldwell, "Adhesion properties of carbohydrate systems."

4 Sept. Mechanics of adhesive bonds: A. F. Martin, "Influence of adhesive physical properties on bonded-joint behavior"; D. K. Kaelble, "A general theory of peel adhesion."

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Lipid Metabolism

Donald B. Zilversmit, *chairman*
Carleton R. Treadwell, *vice chairman*

15 June. Blood coagulation: T. H. Spaet, "The role of lipids in blood coagulation"; A. J. Marcus, "Studies on blood platelet phosphatides"; G. Rouser, "The isolation and characterization of phosphatidyl ethanolamine and its effect on blood coagulation"; J. R. O'Brien, "Lipids in coagulation phenomena in vitro and in thrombosis"; R. L. Swank, "The relation of transport of fats to their physical state in blood."

16 June. Metabolism of adipose tissue: D. W. Fawcett, "Observations on the submicroscopic structure and metabolic responses of brown adipose tissue"; R. A. Liebelt, "Growth characteristics and lipid deposition in adipose tissue of mice"; B. Shapiro, "The mechanism of fat transport in adipose tissue and liver"; K. Bernhard, "Some aspects of the behavior of the polyenic fatty acids in the animal body"; J. F. Mead, "Hydrogenation of polyunsaturated fatty acids in biological systems."

17 June. Role of lipids in enzyme activity: D. E. Green, "The role of lipids in mitochondrial function"; F. L. Crane, "The function of coenzyme Q and other lipids in electron transport"; A. Nason, "The role of lipids in electron transport: tocopherol at the enzymatic level"; S. J. Wakil, "The mechanism of fatty acid biosynthesis"; D. D. Feller, "Incorporation of low-molecular-weight metabolites into lipids by slices of adipose tissue."

18 June. Mechanisms of fat transport: V. P. Dole, "The role of nonesterified fatty acids in fatty acid transport"; D. S. Fredrickson, "The in vivo metabolism of plasma UFA as determined by tracer experiments"; J. J. Spitzer, "Hormonal effects on release and uptake of UFA"; C. M. Radding, "In vitro synthesis of liver lipoprotein"; M. Rodbell, "The nature and metabolism of chylomicron proteins."

19 June. Mechanisms of fat transport: R. P. Geyer, "Utilization of emulsified lipids in vivo and in vitro"; J. Seifter, "The action of the lipid-mobilizing factor."

Physical Metallurgy

Thomas A. Read, *chairman*
Robert L. Fullman, *vice chairman*

Phase Transformations

22–26 June. J. W. Christian, "Martensitic transformations"; T. B. Massalski, "Certain features of transformations that resemble both the martensitic and the nucleation and growth types"; H. W. Paxton, "Interface-controlled transformations in solids"; J. W. Cahn, "The role of diffuse interfaces in transformation kinetics"; R. J. Weiss, "Relation of electron properties of α- and γ-iron to transformation behavior"; Larry Kaufman, "Lattice stability of metals"; Gilbert Speich, "Bainitic growth rates"; C. S. Smith, "Transformation and deformation in metals under explosive shock loading"; V. F. Zackay and J. C. Shyne, "Plastic properties of martensitic steels formed from cold-worked austenite"; W. W. Mullins, "An analysis of the linear cooperative problem as a mark-off process"; P. A. Flinn and G. McManus, "A Monte Carlo calculation of the order-disorder transformation in the body-centered cubic structure"; S. L. Quimby, "Ordering and disordering processes in Cu_3Au"; J. L. Walter, "Surface energy

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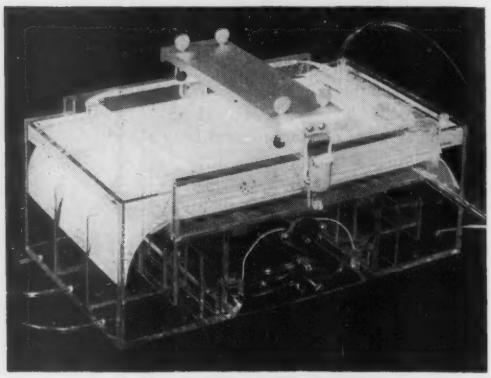

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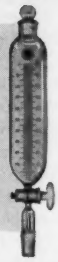

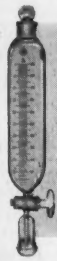

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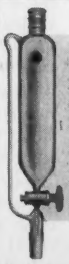

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mechanism for secondary recrystallization"; J. W. Rutter and K. T. Aust, "Grain boundary migration in high-purity metals"; A. G. Tweet, "Supersaturation effects in precipitation in semiconductors"; J. Mitchell, "Precipitation processes in crystals of silver halides"; Brian Berry, "Internal friction studies of precipitation"; L. S. Darken, "Interaction of interstitials with dislocations"; D. Turnbull, "Kinetics of clustering and Guinier-Preston zone formation in alloys"; H. S. Rosenbaum, "The role of dislocation loops in the precipitation of silicon from aluminum"; Mats Hillert, "Some viewpoints on the transformation of austenite."

Nuclear Chemistry

Morris L. Perlman, *chairman*
John O. Rassmussen, *vice chairman*

29 June–3 July. Survey of current problems in the study of nuclear reactions (low-energy region; high-energy region). The initial interaction: experimental evidence for compound nucleus formation and for direct interaction; theory and comparison with experimental results. Decay of compound system. High energy interactions. Heavy ion reactions. Fission.

Solid State Studies in Ceramics

W. D. Kingery, *chairman*

6 July. J. J. Gilman, "Dislocations and mechanical properties of nonmetal crystals"; S. Amelinckx, "Dislocation structure in nonmetal crystals."

7 July. R. J. Stokes, "The mechanical properties of MgO crystals"; G. R. Pulliam, "The influence of environment on flow and fracture of single crystals."

8 July. J. B. Wachtman, Jr., "Damping capacity of polycrystalline ceramics"; R. M. Fulrath, "Polycrystalline and polyphase ceramics"; J. Selsing, "Fracture in polyphase ceramics."

9 July. G. R. Eusner, "Mechanical properties of basic brick"; W. J. Young, "Research studies on art forgeries."

10 July. C. C. Evans, "Mechanical properties of nonmetal whiskers." Discussion leaders: I. B. Cutler, P. Gibbs, A. E. Gorum, J. Gurland, M. L. Kronberg, T. S. Shevlin, T. L. Johnston, J. W. Mitchell, P. L. Pratt, R. Bacon, E. Ruh.

Chemistry, Physiology, and Structure of Bones and Teeth

W. D. Armstrong, *chairman*
B. B. Migicovsky, *vice chairman*

13 July. Invited short communications (Felix Bronner, *chairman*). *Bone as a mechanical tissue* (Jonathan Cohen, *chairman*): G. H. Bell, "Bone as a problem in mechanical engineering."

14 July. F. G. Evans, "The relation of the microscopic structure of bone to its strength characteristics and other physical properties"; H. Hollingshaus, "Mechanical properties of bone from radium-

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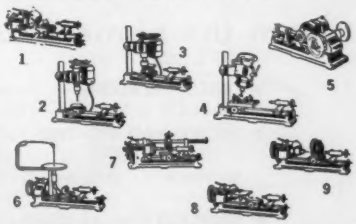

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poisoned dogs"; W. T. Dempster, "The distribution of osseous material in the mandible and humerus, and its mechanical importance"; M. G. Hardinge, "The transmission of weight through the knee joint." *Fluoride metabolism* (Harold C. Hodge, *chairman*): D. A. Greenwood, "Broad aspects of fluoride metabolism"; Yngve Ericsson, "Radiofluoride studies."

15 July. P. H. Phillips, "Bone retention of fluoride"; C. S. Hobbs, "Radiofluoride distribution in animals under chronic fluoride exposure"; E. J. Largent, "Urinary fluoride levels in relation to change in osseous radiopacity"; F. J. McClure, "Fluoride content and the chemistry of human skeletal tissue"; C. H. Carlson, "Mechanisms of renal excretion of fluoride determined with radiofluoride"; Leon Singer, "Plasma fluoride concentrations in relation to fluoride intake." *New developments in methodology in study of calcified tissues* (D. Dziewiatkowski, *chairman*): Diego Carlström, "Some new aspects of ultrastructure of bone."

16 July. James Irving, "Histochemical changes at sites of calcification"; Richard Gruelich, "High-resolution microradiography"; Harold Schraer, "Quantitative determination of bone mineral content and bone density in vivo from standardized roentgenograms." *Pathological physiology of bone and calcium metabolism* (Franklin C. McLean, *chairman*): G. Fanconi, "Idiopathic hypercalcemia."

17 July. Albert Dorfman, "Studies on acid mucopolysaccharides (Hurler's syndrome)"; Donald Fraser, "Hypophosphatasia"; Karl M. Wilbur, "Mechanisms of mineralization in mollusks."

Cell Structure and Metabolism

A. K. Solomon, *chairman*
Alan J. Hodge, *vice chairman*

Biological Membranes

20 July. Structure and cellular aspects of membranes: George E. Palade; Heinz Holter; Manfred L. Karnovsky.

21 July. Molecular architecture of the membranes: F. O. Schmitt; J. B. Finean; W. Stoeckenius: J. Lawrence Oncley; J. D. Robertson.

22 July. Transport across cellular membranes: Hans H. Ussing; John R. Pappenheimer A. K. Solomon; Paul Lefevre; Alan Hodgkin and Richard Keynes.

23 July. Physics and chemistry of membranes: George Scatchard; Torsten Teorell; R. Schlögl; Theodore Shedlovsky.

24 July. Metabolic functions of membranes: Albert L. Lehninger; Eric G. Ball; Philip Siekevitz.

A grant from the Muscular Dystrophy Associations of America and the Muscular Dystrophy Association of Canada has provided support for the travel of the foreign scientists.

Chemistry at Interfaces

Norman Hackerman, *chairman*
Herman E. Ries, *vice chairman*

27 July. Metal-solution interfaces (R. S. Hansen, *chairman*): R. S. Hansen, "Relaxation phenomena in the double layer"; Norman Hackerman, "The electrical double layer at solid metal-solution interfaces"; J. O'M. Bockris, "Adsorption of nonelectrolytes of metal-solution interfaces."

28 July. Dispersions (F. R. Eirich, *chairman*): E. Matijewic, "Formation of solid phases in electrolyte solutions"; J. J. Chessick, "Stability of dispersions in nonaqueous media"; A. J. Rutgers, "Ionic hydration in aqueous solutions."

29 July. Adsorption (R. A. Beebe, *chairman*): H. S. Taylor, "Aspects of chemisorption and catalysis"; G. H. Young, "Chemisorption studies from fuel cell potentials (applications of a new tool in chemisorption studies)"; D. H. Everett, "Adsorption hysteresis."

30 July. Adsorption (continued) (A C. Zettlemoyer, *chairman*): J. R. Zimmerman, "Water vapor adsorption on silica gel by nmr techniques"; J. G. Aston, "Adsorption studies by nmr."

31 July. Monolayers on liquids (H. W. Fox, *chairman*): L. Jarvis, "Monolayers on nonaqueous substrates."

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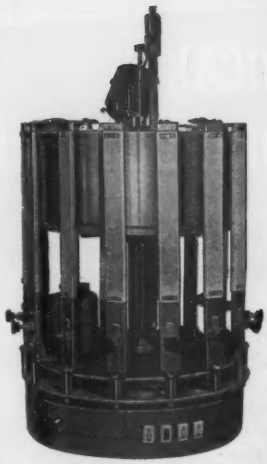

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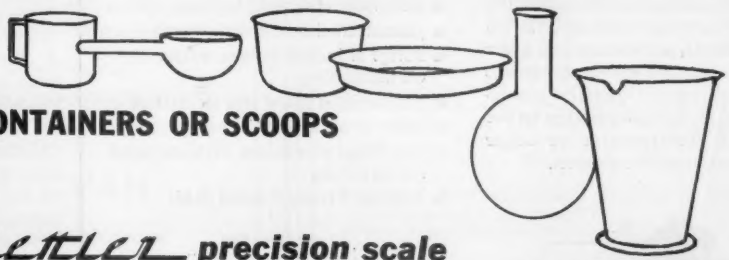

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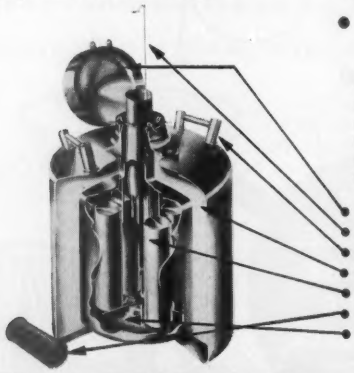

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Biochemistry and Agriculture

George L. McNew and Robert S. Bandurski, *cochairmen*

3 Aug. The biochemical basis of ecological response (Hubert Martin, *chairman*): Z. A. Patrick, "Root diffusates and decomposition products of plant residues as factors in crop ecology"; David Gottlieb, "The role of symbiosis and antibiosis in the soil community"; P. W. Brian, "Biochemical basis of microbial antagonisms in soil"; E. E. Smissman and S. D. Beck, "Biochemical basis of pathogenesis"; R. A. Ludwig, "The function of biologically active compounds in the growing plant in pathogenesis and defense mechanisms."

4 Aug. Phosphorus in plant nutrition (G. C. Bridger, *chairman*): D. R. Bouldin, "Chemical behavior and plant availability of phosphorus sources in relation to soil and fertilizer properties"; A. J. Ohlrogge, "Plant-nutrient uptake from fertilizer bands"; C. V. Cole, "Distribution of phosphorus in plants." *Metabolism of adenyl anhydrides* (Robert S. Bandurski, *chairman*): G. C. Webster, "Amino acid activation and protein synthesis"; R. S. Bandurski, "Sulfate activation and reduction."

5 Aug. Chemistry and metabolism of nucleic acids (Paul O. P. Ts'o, *chairman*): J. Herbert Taylor, "DNA and RNA synthesis"; Paul O. P. Ts'o, "Structure and properties of microsomal particles and their RNA"; P. C. Cheo, "Physical-chemical properties and infectivity of tobacco mosaic virus RNA"; K. K. Reddi, "Studies on tobacco mosaic virus nucleic acid." *Uridine diphosphate sugars and polysaccharide synthesis* (W. Z. Hassid, *chairman*): E. Neufeld, "Mechanism of sugar nucleotide synthesis in higher plants"; L. Glaser, "Polysaccharide synthesis from uridine linked sugars."

6 Aug. The inhibition of metabolic functions by synthetic chemicals (H. P. Burchfield, *chairman*): Paul H. Schuldt, "Activation of cyclic sulfones by dehydrochlorination"; Donald E. Moreland, "Biochemistry of herbicidal action including effects on the Hill reaction"; R. D. O'Brien, "Mechanism and significance of esterase inhibition by phosphates and carbamates." *Special conference addresses on the regulation of plant growth* (A. G. Norman, *chairman*): T. A. Bennet-Clark, "Possible mechanisms of plant growth regulation"; R. L. Wain, "Some chemical aspects of plant growth regulation."

7 Aug. Effect of ionizing radiation on biochemical processes (James L. Liverman, *chairman*): B. S. Schweigert, "Biochemical aspects for the radiation preservation of food"; Charles O. Doudney, "Macromolecular synthesis in the mutagenic and lethal effects of radiation in bacteria"; Henry Quastler, "Comparative radiosensitivity of living organisms."

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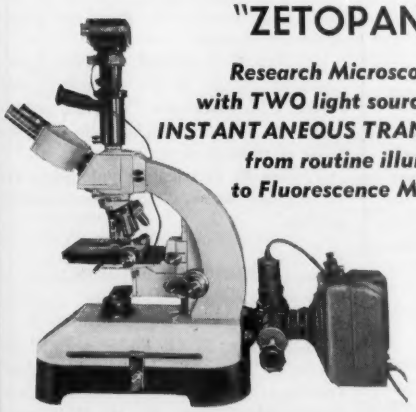

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10 Aug. David W. Fassett, *chairman*: Irvin Blank, "Basic mechanisms of percutaneous absorption"; Albert A. Kondritzer, "Physical-chemical factors in the development of barrier materials"; Leonard J. Vinson, discussion. John A. Zapp, Jr., *chairman*: G. W. H. Schepers, "Pulmonary tissue changes induced by inhaled industrial dust."

11 Aug. Kingsley Kay, *chairman*: speaker and subject to be announced; Henry F. Smyth, "Deriving tentative threshold limits from experimental data." Charles R. Williams, *chairman*: Charles Kensler, "Quantitative aspects of chemical carcinogenesis"; Miriam P. Finkel, "Quantitative aspects of radioisotope carcinogenesis."

12 Aug. Eugene H. Krackow, *chairman*: Eugene H. Krackow, "Extension of laboratory toxicological data to the field of industrial medicine"; C. Boyd Shaffer, "Prospectively"; W. Clark Cooper, "Retrospectively." Norton Nelson, *chairman*: George M. Knauf, "Biological effects of microwave energy." Film, "Medical aspects of missile operations."

13 Aug. Horace Gerarde, *chairman*: Joseph H. Gast, "The biological effects of chemical agents on in vitro systems." Bernard L. Oser, *chairman*: H. van Genderen, "Interpretation of toxicological data in animals for the determination of acceptable levels for intake in man."

14 Aug. Geoffrey Woodward, *chairman*: Frederick S. Phillips and Stephen S. Sternberg, "Experimental and clinical toxicity of cancer chemotherapeutic agents"; William Layton, "Some problems in evaluation of the safety of drugs."

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Lattice Dynamics

17 Aug. P. M. Marcus, "Specific heats and vibration spectra"; J. A. Morrison, "Present status of low-temperature specific-heat measurements"; J. A. Krumhansl, "Microscopic theories of elasticity as tested in anisotropic substances—graphite."

18 Aug. B. N. Brockhouse, "Inelastic neutron scattering—Chalk River results"; H. Palevsky, "Inelastic neutron scattering—Brookhaven results"; M. Lax, "Long-range forces and lattice vibrations in germanium"; E. Burstein, "Infrared observations and lattice dynamics."

19 Aug. H. B. Rosenstock, "Far-infrared lattice absorption"; W. C. Overton, Jr., "Vibration spectra and critical points in F.C.C. lattices with nearest and next-nearest neighbor interactions"; J. DeLaunay, "Vibration spectrum calculations"; A. Maradudin, "Effects of defects and disorder on vibrational properties of crystals."

20 Aug. G. Leibfried, "Recent developments in the theory of anharmonic effects"; M. Blackman, "Thermal expansion"; R. W. Morse, "Acoustic observations of phonon-electron interactions."

21 Aug. C. Herring, "Phonon-drag effects"; M. Walsh, "Spin-phonon interactions."

Photonuclear Reactions

Peter Axel and
A. O. Hanson, *cochairmen*

24–28 Aug. E. G. Fuller and R. B. Duffield, "Systematics of photonuclear reactions." Current experimental programs. M. Danos, D. H. Wilkinson, "Theory of photonuclear reactions." Energy levels in light nuclei. Theoretical interpretation of light nuclei. Bremsstrahlung and non-nuclear gamma ray interactions. Photonuclear and inverse reactions (experimental). Theoretical interpretation of inverse reactions. Remaining uncertainties and controversies.

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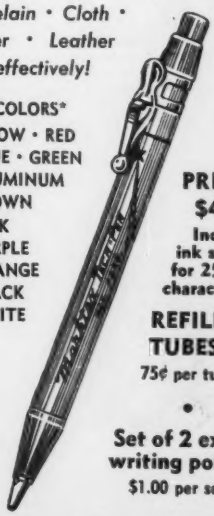

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31 Aug. H. Flood, M. Blander, "Activity"; F. R. Duke, "Kinetics."

1 Sept. J. O'M. Bockris, "Transport properties"; B. R. Sundheim, "Transference."

2 Sept. D. M. Gruen, "Spectrophotometry"; G. Janz, "Raman spectra x-ray."

3 Sept. D. D. Cubicciotti and M. Bredig, "Metals in molten salts."

4 Sept. L. Brewer and R. Porter, "High-temperature chemistry."

Forthcoming Events

April

2–3. Electrical Applications for the Textile Industry, AIEE conf., Atlanta, Ga. (N. S. Hibshman, AIEE, 33 W. 39 St., New York 18.)

2–3. Radioisotopes in Agriculture, 4th conf., Stillwater, Okla. (J. H. Jensen, Associated Midwest Universities, Iowa State College, Ames.)

3–4. Marine Biology, 20th annual, Corvallis, Ore. (J. E. McCauley, Dept. of Zoology, Oregon State College, Corvallis.)

5–9. International Acad. of Proctology, 11th annual, New York, N.Y. (A. J. Cantor, IAP, 147–41 Sanford Ave., Flushing 55, N.Y.)

5–10. American Chemical Soc., 135th, Boston, Mass. (M. A. H. Emery, 18th and K St., NW, Washington, D.C.)

5–10. Nuclear Congress, Cleveland, Ohio. (S. Baron, Burns & Roe, Inc., 160 West Broadway, New York 13.)

6. Paleontological Research Institution, Ithaca, N.Y. (R. Harris, 109 Dearborn Rd., Ithaca.)

6–7. Chemical and Petroleum Instrumentation, 2nd natl. symp., St. Louis, Mo. (H. S. Kindler, Director of Technical and Educational Services, ISA, 313 Sixth Ave., Pittsburgh 22, Pa.)

6–8. American Radium Soc., Hot Springs, Va. (R. L. Brown, Robert Winship Clinic, Emory Univ., Atlanta 22, Ga.)

6–8. National Open Hearth Steel Furnace, Coke Oven and Raw Materials Conf., St. Louis, Mo. (E. O. Kirkendall, AIME, 29 W. 39 St., New York 18.)

6–9. American Acad. of General Practice, San Francisco, Calif. (M. F. Cahal, Volker Blvd. at Brookside, Kansas City 12, Mo.)

6–11. Coordination Chemistry, intern. conf., London, England. (Chemical Soc., Burlington House, London, W.1.)

8. Evolution of Cell Populations, conf. (by invitation), Atlantic City, N.J. (D. C. Hetherington, Dept. of Anatomy, Duke Univ. School of Medicine, Durham, N.C.)

8–9. Tissue Culture Assoc., 10th annual, Atlantic City, N.J. (D. C. Hetherington, Dept. of Anatomy, Duke Univ. School of Medicine, Durham, N.C.)

10–11. Society for the Scientific Study of Religion, Chicago, Ill. (W. H. Clark, SSSR, Hartford Seminary Foundation, Hartford 5, Conn.)

10–16. Mental Health, 2nd Caribbean conf., St. Thomas, Virgin Islands. (Mrs. E. L. M. Shulterbrandt, Bureau of Mental Health, St. Thomas, V.I.)

12–13. American Soc. for Artificial Internal Organs, Atlantic City, N.J. (C. K. Kirby, ASAIO, 110 Maloney Bldg., University Hospital, 3600 Spruce St., Philadelphia 4, Pa.)

12–14. Atomic Mechanisms of Fracture, conf., Cambridge, Mass. (D. K. Felbeck, Natl. Acad. of Sciences–Natl. Research Council, 2101 Constitution Ave., NW, Washington 25.)

12–15. Neurosurgery, 8th Latin American cong., Santiago, Chile. (A. Asenjo G., Casilla 70-D, Santiago, Chile.)

12–16. American Physiological Soc., Atlantic City, N.J. (R. C. Daggs, 9650 Wisconsin Ave., Washington, D.C.)

12–16. Fracture, intern. conf., Cambridge and Dedham, Mass. (Headquarters, Air Force Office of Scientific Research, Washington 25.)

13. Biochemical Cytology of Liver (Histochemical Soc.), symp., Atlantic City, N.J. (A. B. Novikoff, Dept. of Pathology, Albert Einstein College of Medicine, Yeshiva Univ., Eastchester Rd. and Morris Ave., New York 61.)

13–15. Hydraulics Conf. (American Soc. of Mechanical Engineers), Ann Arbor, Mich. (O. B. Schier, ASME, 29 W. 39 St., New York 18.)

13–17. American Assoc. of Immunolo-

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Talvitie, N. A. and Hyslop, Frances
American Industrial Hygiene Association Journal, 9(1)54-58, Feb., 1958

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Campbell, J. B., Bassett, C. A. L., Husby, J. and Noback, C. R.
Surgical Forum, Vol. VIII, 1958

Millipore BRIEF #254

Exfoliated Cytology of the Urinary Tract: A New Approach with Reference to the Isolation of Cancer Cells and the Preparation of Slides for Study.

A new Millipore filter technique for the retention of cells to be stained by hematoxylin and eosin, and Papanicolaou and other staining methods has been reported. This new technique eliminates the unsatisfactory smears due to lack and loss of cells in urinary tract exfoliated cytology which previously have been reported as high as 58 per cent in proved cases of exfoliating cancer of the bladder, ureter or renal pelvis.

Solomon, C., Amelar, R., Hyman, R. M. Chaiban, R., and Europa, D. L.
The Journal of Urology, 80(5)374-382, Nov., 1958

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The Preparation of Tuberculous Sputum for Membrane Filter Filtration.

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McKinney, Ruth A.
The American Review of Tuberculosis and Pulmonary Diseases, 77(6)1019-1022, June, 1958

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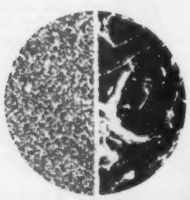

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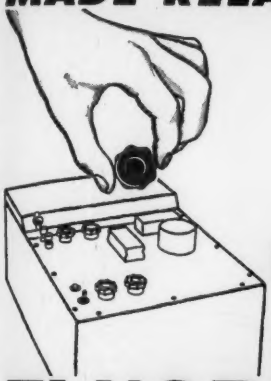

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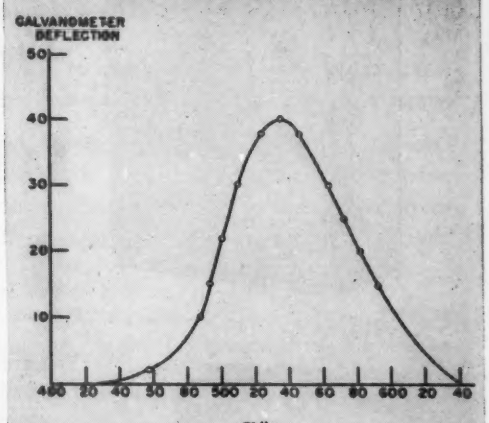
MAX L. SWEAT, Anal. Chem. Vol. 26, Pg. 773



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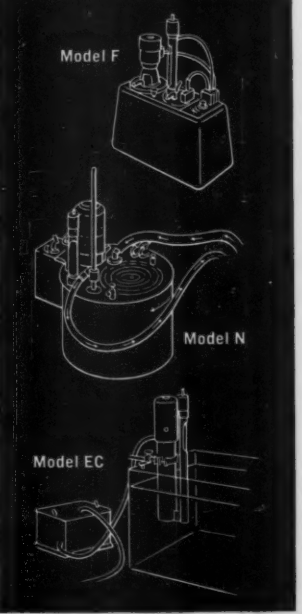

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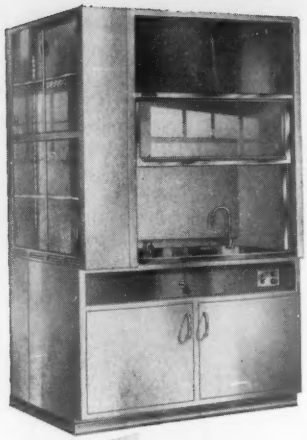

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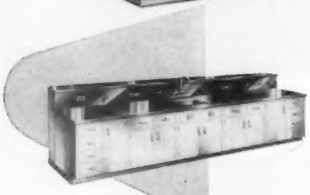

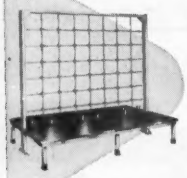

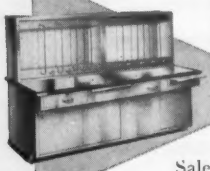

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13–17. American Soc. for Pharmacology and Experimental Therapeutics, Atlantic City, N.J. (H. Hodge, Univ. of Rochester, Rochester 20, N.Y.)

13–18. American Acad. of Neurology, Los Angeles, Calif. (J. M. Foley, Boston City Hospital, Boston, Mass.)

13–18. American Soc. of Biological Chemists, Atlantic City, N.J. (F. W. Putnam, Univ. of Florida Medical School, Gainesville.)

13–18. American Soc. for Experimental Pathology, Atlantic City, N.J. (J. F. A. McManus, Univ. of Alabama Medical Center, Birmingham 3.)

14–15. Electrical Heating Conf. (American Institute of Electrical Engineers), Philadelphia, Pa. (N. S. Hibshman, AIEE, 33 W. 39 St., New York 18.)

14–16. Faraday Soc. (Energy Transfer), Nottingham, England. (Faraday Soc., 6 Gray's Inn Sq., London, W.C.1, England.)

14–16. Life Span of Animals, 5th colloquium on aging, London, England. (Ciba Foundation, 41 Portland Pl., London, W.1.)

14–16. Rheology of the Glassy State (British Soc. of Rheology), Sheffield, England. (D. W. Saunders, British Rayon Research Assoc., Heald Green Laboratories, Wythenshawe, Manchester 22, England.)

15–17. American Assoc. of Genito-Urinary Surgeons, Absecon, N.J. (W. J. Engel, 2020 E. 93 St., Cleveland 6, Ohio.)

15–17. American Surgical Assoc., San Francisco, Calif. (W. A. Altemeier, Cincinnati General Hospital, Cincinnati 29, Ohio.)

15–17. Midwest Benthological Soc., annual, Hickory Corners, Mich. (C. M. Fetterolg, Jr., Water Resources Commission, Sta. B, Lansing 13, Mich.)

16–18. American Assoc. of Railway Surgeons, Chicago, Ill. (C. C. Guy, 5800 Stony Island Ave., Chicago 37.)

16–18. Association of South Eastern Biologists, Knoxville, Tenn. (H. J. Humm, Dept. of Botany, Duke Univ., Durham, N.C.)

16–18. Ohio Acad. of Sciences, Columbus. (G. W. Burns, Ohio Wesleyan Univ., Delaware.)

16–18. Southern Sociological Soc., 22nd annual, Gatlinburg, Tenn. (S. C. Mayo, North Carolina State College, Raleigh.)

16–30. Engineering, Marine, Welding and Nuclear Energy Exhibition, 22nd, Olympia, London. (F. W. Bridges & Sons, Ltd., Grand Buildings, Trafalgar Square, London, W.C.2, England.)

17. Current Developments in the Production of High Vacua, symp., London, England. (Institute of Physics, 47 Belgrave Square, London, S.W.1.)

17–18. American Mathematical Soc., Monterey, Calif. (E. G. Begle, Leet Oliver Hall, Yale Univ., New Haven, Conn.)

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(See issue of 20 February for comprehensive list)

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Advertisements. Check number of page on which ad appears. **U,** upper ad; **M,** middle ad; **L,** lower ad; **I,** inside ad; **O,** outside ad. If more than one item appears in an ad, indicate at the bottom of the card which item is of interest; otherwise the request cannot be processed.

Equipment. Circle number corresponding to the number given at the end of each paragraph in the Equipment columns (pages 666-668).

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Advertisements

586	587	588	589	590	591	592	593	594
595	596	597	598	599	600	601	602	603
604	605	606	607	608	610	611	612	614
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665	666, U	666, L	667	668	669, UI	669, UO	669, L	670, UO
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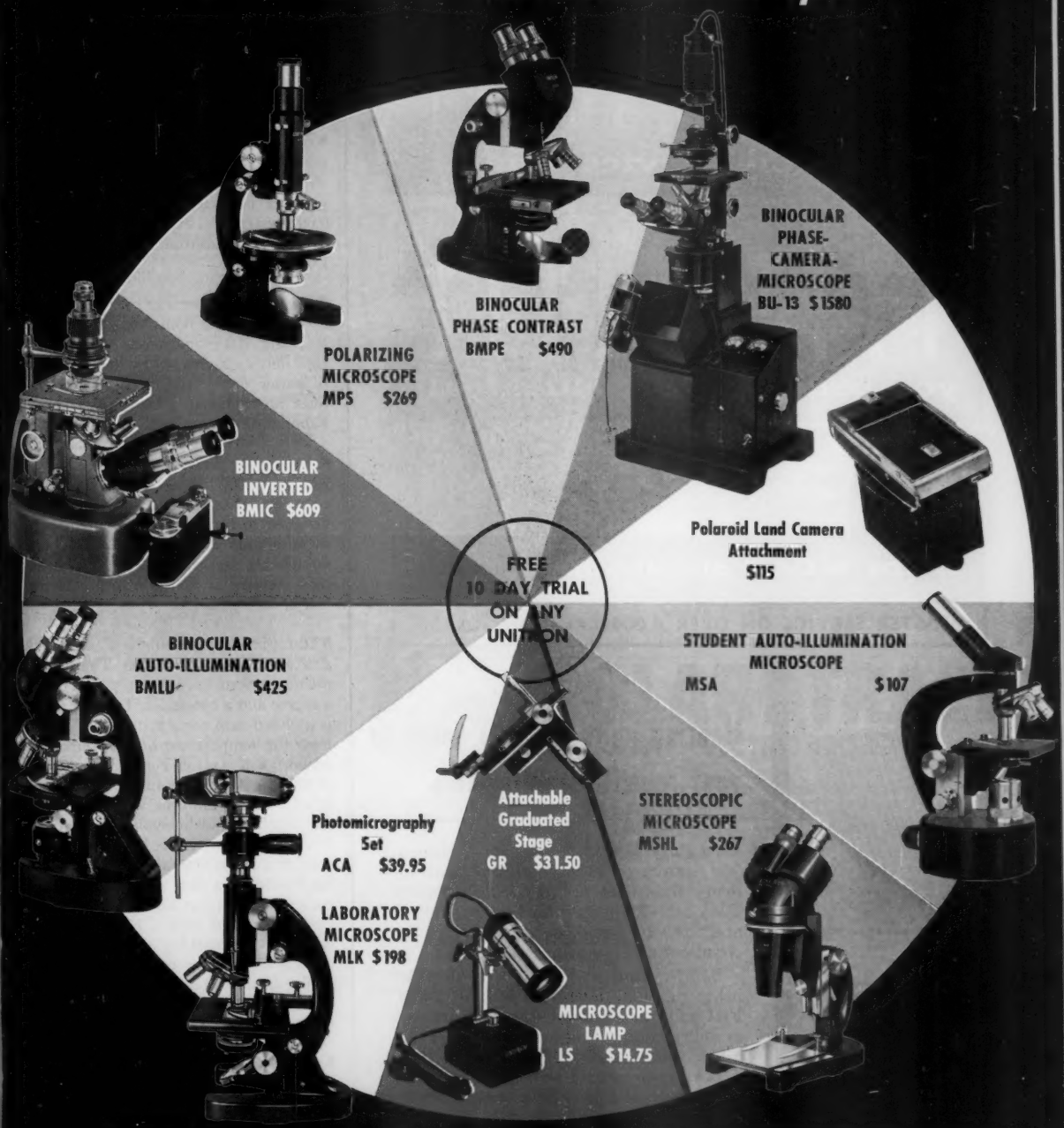
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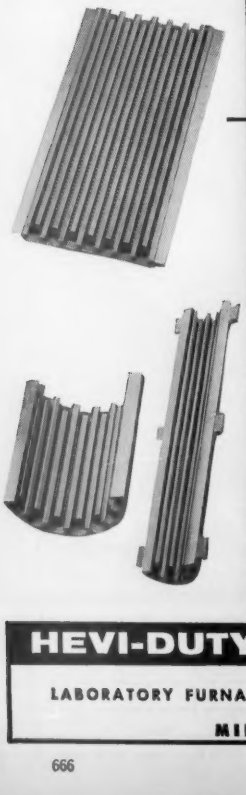

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Equipment

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■ VOLTAGE REFERENCE combines a temperature-compensated Zener diode and an amplifying transistor. Combined temperature coefficient may be as low as 0.002 percent/°C over the range −55° to +100°C. (Transitron Electronic Corp., Dept. 663)

■ MAGNETRON TEST KIT can be used in the field to test both X- and C-band, 100- and 400-w magnetrons. The portable unit measures 22 by 15 by 19 in. A power meter and a spectrum analyzer are optional accessories. (Bomac Laboratories, Inc., Dept. 664)

■ FREQUENCY STANDARDS for the range 200 to 10,000 cy/sec are dynamically balanced electromechanical resonators designed to function without frequency or amplitude modulation in severe environments. Accuracy is ±0.01 percent. All circuitry is transistorized. (Gyrex Corp., Dept. 660)

■ BLACK-BODY REFERENCE is a controlled source of infrared radiation. The instrument is constructed as two separate units, a source and a controller. The controller is a closed-loop servo system that maintains the temperature of the source by proportional control. Temperature range is 200° to 600°C. Temperature stability is ±1.5°C for ambient variations from 16° to 38°C and line-voltage variations from 105 to 125 v. The black body consists of an accurate aperture plate behind which is a pure silver core with a conically shaped radiating cavity. The cavity is coated with a black finish of emissivity approaching unity. Cosine radiation distribution is achieved over a 20-deg field for standard apertures 0.040 and 0.015 in. in diameter. (Perkin-Elmer Corp., Dept. 667)

■ POWER GENERATOR for 400-cy/sec power is an integral unit consisting of a motor, inductor alternator, and regulating equipment. Power ratings from 1.5 to 10 kw and a variety of output voltages are available. Voltage is regulated to ±3 percent; ±1 percent regulation can be obtained. Driving motors can be supplied for voltage and phases required by the application. (Safety Industries, Inc., Dept. 668)

■ BAROSTAT operates on dead-weight principle to achieve reproducibility said to be approximately ±0.005 in.-Hg. Weights loaded on a pan are supported

by the regulated pressure in a bellows. Another evacuated bellows eliminates atmospheric pressure. When the force due to the pressure exceeds that of the suspended weights, the supporting plate actuates a valve leading to a vacuum pump. Weights are added and removed by an electrically operated cable lift. The change from atmospheric pressure to 3.44 in.-Hg, corresponding to 50,000-ft altitude, can be accomplished in 30 sec. (National Instrument Laboratories, Inc., Dept. 669)

■ MAGNETIC-TAPE-EQUIPMENT TEST SET permits frequency-response measurements of amplifiers; measurement of magnetic-head record and bias current and amplifier input-output levels; calibration of FM record amplifiers; setting up of pulse-density mode recording and equalization of analog reproduce amplifiers. The set includes volt-ohm-milliammeter, audio oscillator, vacuum-tube voltmeter, oscilloscope, and voice amplifier. A patch panel permits various circuit arrangements. (Consolidated Electrodynamics Corp., Dept. 671)

■ GALVANOMETER MASK consists of a block holding adjustable blades that can be lowered to interrupt light from any galvanometers in a multichannel oscillograph. The mask will withstand accelerations in excess of those for which the oscillograph is designed. Up to 52 channels can be masked. (L-W Photo Products, Dept. 673)

■ PRESSURE TESTER balances air pressure against a known weight. Range is 0.20 to 15 lb/in.^{2} without cylinder or piston change. Increments of 0.1 lb/in.^{2} can be set. Accuracy is ±0.05 percent of full scale. A self-contained source supplies filtered compressed air; an external source may also be used. (Dynametrics Corp., Dept. 675)

■ AMPLITUDE MODULATOR provides 100-percent modulation over the range from d-c to 1000 Mcy/sec. Modulation frequency range is 15 cy to 15 kcy/sec. Percentage modulation is continuously variable. Radio-frequency input voltage is up to 2.0 v r.m.s. Input impedance is 50 ohm. Drift is not more than 5 cy/sec in 5 min at normal operating temperature. The modulator is transistorized and powered by mercury batteries. (Kay Electric Co., Dept. 670)

■ OXYGEN ANALYZER is improved by the addition of automatic calibration at predetermined intervals. The calibrator operates with a mixture of gases in which the oxygen content is known within ±0.1 percent. Calibration frequency can be set for 2-, 4-, 6-, 8-, or 12-hr intervals. The calibrator operates for about 5 min; during this period several adjustments may

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be made to position pointers correctly. Use of the automatic calibrator is said to eliminate need for thermostating. The instrument may be used in hazardous locations. (Mine Safety Appliance Co., Dept. 672)

■ R-I-E METER measures current, resistance, and voltage. Resistance range is 2×10^2 to 2×10^8 megohm with limits of error between ± 1.7 and ± 6 percent of reading. Current range is 10^{-12} to 5×10^{-6} amp with error limits from ±1.5 to ± 3 percent of full scale. Voltage range is 0.005 to 500 v with error limits between ± 0.5 to ± 3 percent of full scale. A self-contained power pack supplies either 10 or 100 v. (Leeds and Northrup Co., Dept. 676)

■ POWER SUPPLIES employ nickel-cadmium batteries maintained in a fully charged condition at all times by a constant-potential charger. The charger is designed to supply both the external constant load and the trickle charge current. High current peaks are permitted by the low internal resistance of the batteries. A 7 AH cell, for example, will deliver 75 amp. (Gulton Industries, Inc., Dept. 677)

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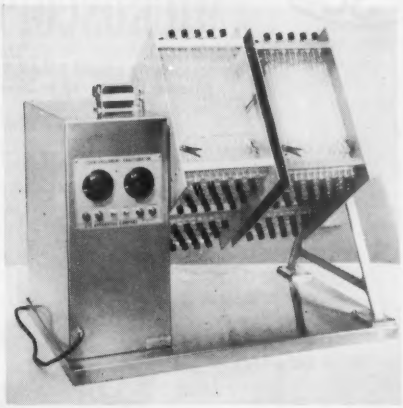

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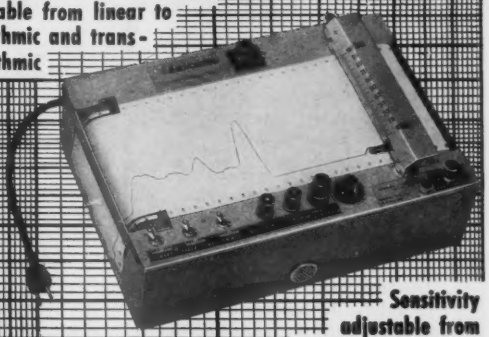

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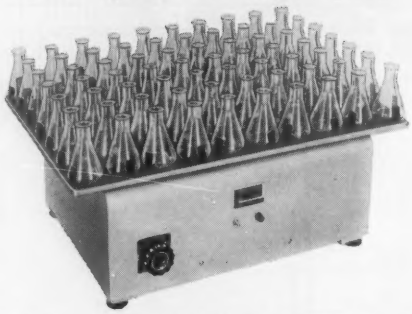

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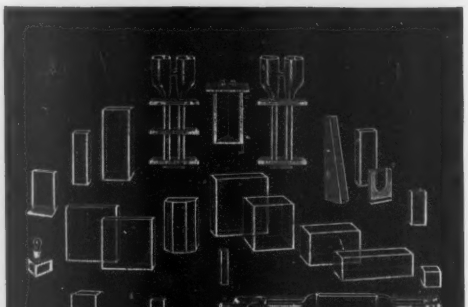

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(Continued from page 610)

tems standpoint, particularly employing even the simpler concepts of feed-back theory, he finds himself tending toward teleological expressions, because they are far more accurate and conservative of words than "mere" statement of relationship among "fundamental" variables. Feed-back systems are best discussed with transitive verbs.

In any case, where a closed chain of cause-effect relationships is known to exist, feed-back exists, by definition, and in living systems this feed-back is often both significant and of the correct sign to qualify as negative feed-back. All negative feed-back systems can properly be thought of as control systems, and all control systems operate to maintain their input signals at some "reference level." The reference level might be set where it is as a result of physical properties of the control-system components, or it might be determined by a signal entering the control system from outside it. This reference level is in all respects a *goal* for the system. The system will (within its limits of complexity) produce whatever outputs are required by the momentary environment to bring its input to this reference level.

In other words, one can say with clear meaning that the *purpose* of the system's behavior is to make its inputs approach some goal state. Many modern psychologists have unfortunately rejected this language for discussing behavior because it is teleological or "anthropomorphic," but one is here properly accused of speaking anthropomorphically only when he tries to describe the goal of a control system in terms appropriate to himself rather than to the control system. To make this clear, let us look at one of Bernatowicz' examples.

"There has to be some sort of mechanism for raising sap [in trees], and energy is lavishly expended in the process." The word *lavishly* aside, this is clearly a hypothesis that a control system exists. But the "goal" of the system has been expressed in the observer's, not the system's, terms: "raising sap" is one event that a human observer might notice, to be sure, but the plant can hardly be suspected of being directly sensitive to the height of the sap column. Rather, we might guess that the presence or absence of sap in critical portions of the tree affects biochemical processes, and some of the products of these processes may well be controlled variables for which specific "reference levels" are determined by the plant's physical properties.

The control system which maintains this kind of variable at a particular level does so by controlling the transfer of energy from storage into work or chemical synthesis; thus, it is quite appropriate to use the transitive verb *expend*.

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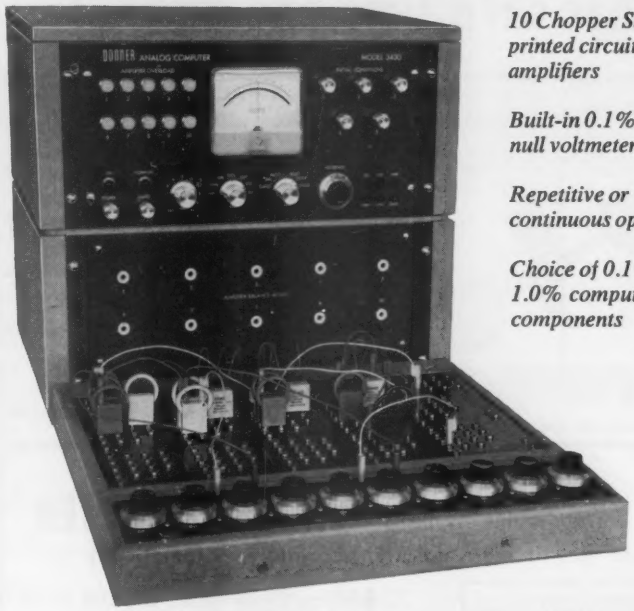

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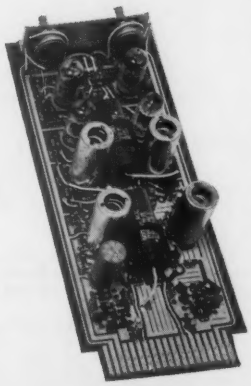

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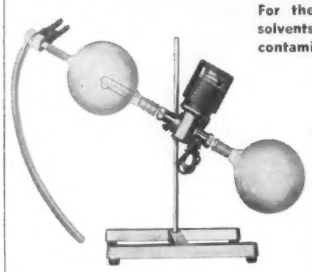

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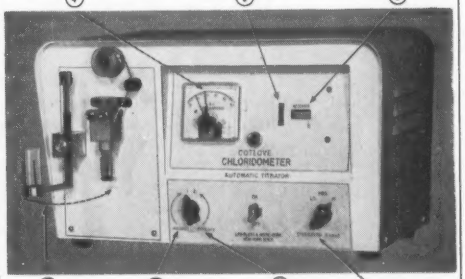

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properly rejected when scientists realized that they were projecting their own goals into the systems they were studying. Indeed, lacking the basic concept of feedback system, they could only study scientifically those systems in which "straight-through" space-time relationships were predominant. But when at last scientific thought began to develop in studies of living systems, the lesson had been learned too well, and what proved a crucial advance in the development of physics and chemistry may now turn out to have been in some ways a backward step in the life sciences. The rejection of teleology ultimately enabled students of behavior to develop reliable means for accumulating data, but it may have been that very step which so far has prevented the organization of those mountains of data into comprehensive theories, not only in psychology but in biology, biochemistry, medicine, sociology, and so forth.

If I have succeeded in communicating anything, I hope it is this: teleological concepts can be misused, but the ideas of purpose, goal, or directivity that they denote are both appropriate and proper when one speaks of control systems; I believe at the moment, along with many others, that feed-back control is a pervasive and fundamental feature of living systems. Perhaps it is time that at least the students of living creatures reconsider their goal of rejecting teleological concepts *in toto*. Perhaps in this way we might at last arrive at an "anthropomorphic" theory of human behavior.

WILLIAM T. POWERS

Veterans Administration Hospital, Chicago, Illinois

A. J. Bernatowicz says (page 1404), "To the beginner, the idea of natural law presupposes a lawgiver. . . ." Why only to a beginner? Beginner in what? I would say that to any clear thinker the idea of natural law presupposes a lawgiver.

And I fully intend the implication that anyone who succeeds in not drawing this conclusion is not a clear thinker.

ANTHONY STANDEN

Interscience Publishers, New York

Bernatowicz' rogues' gallery of teleologists may be augmented by one far more important than any he quotes: "What can be more curious than that the hand of man, formed for grasping, that of a mole for digging, the leg of a horse, the paddle of the porpoise, and the wing of the bat, should all be constructed on the same pattern . . ." (*1*).

Not all of Bernatowicz' teleologists, animists, and anthropomorphists are villains. Some are ignorant and some merely careless. The author of my quo-

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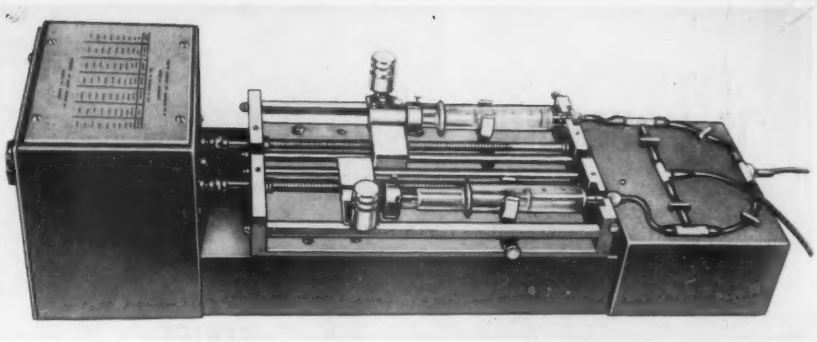

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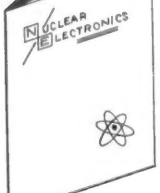

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tation cannot be judged ignorant, even now that we have a century's advantage of him. He polished with a lapidary's care and can hardly have let this and other similar passages stand through six editions from simple oversight. As for being a villain, he is the very archhero of antiteleology. Can it be that Bernatowicz has overlooked one of "the usual excuses," or that he has in certain instances mistaken something else for teleology?

Among the things most characteristic of organisms—most distinctive of living as opposed to inorganic systems—is a sort of *directedness*. Their structures and activities have an *adaptedness*, an evident and vital *usefulness* to the organism. With sterile rigor one may say that "the hand of man grasps," that "sap rises in trees," or that "sea turtles go ashore and lay their eggs." How coincidental it is that such activities just happen to serve the necessities of the organism and of its species! How downright providential! How, in short, inescapably teleological! The "rigorous" statement lands us again squarely in the pre-Darwinian dilemma.

Darwin's answer and ours is to accept the common-sense view that "the hand of man [is] formed for grasping" (*1*), that "there has to be some sort of mechanism for raising sap" (*2*), and that "turtles go ashore to lay their eggs" (*2*) to the end (*teleos*) that the individual and the species may survive. But this end is (usually) unconscious and impersonal. Naive teleology is controverted not by ignoring the obvious existence of such ends but by providing a naturalistic, materialistic explanation of the adaptive characteristics serving them. Surely that is clear enough in the large, omitted context (for example, in *2*) of some of Bernatowicz' brief excerpts. It has recently been quite fully and, I think, lucidly discussed by one of the authors condemned by Bernatowicz (*3*). Because *teleology* has indeed become a dirty word, Pittendrigh has suggested that this undeniable end-directedness of evolution and of organisms be called "teleonomy."

With Bernatowicz, "we stand against the evil" of man- or god-oriented teleology, of animistic personification, and of illegitimate anthropomorphism. We stand equally against the "evil" of vitalism. (By the way, is such emotional language "rigorous"?) But when teleonomy, *sensu* Pittendrigh, is mistaken for teleology, "rigor" becomes evasion. It is stark reductionism that denies to life its most essential characteristics. It is a blind alley leading only to a biology without *bios*.

GEORGE GAYLORD SIMPSON
American Museum of Natural History and Columbia University, New York

References

1. C. Darwin, *On the Origin of Species* (Murray, London, 1859).
2. G. G. Simpson, C. S. Pittendrigh, L. H. Tiffany, *Life: An Introduction to Biology* (Harcourt, Brace, New York, 1957).
3. C. S. Pittendrigh, in A. Roe and G. G. Simpson, Eds., *Behavior and Evolution* (Yale Univ. Press, New Haven, Conn., 1958), chap. 18.

From a microcosmic listening post the following ditty was picked up and recorded. There is uncertainy as to the author.

The Man and the Electron

Said A. J. B. to the electron,
"It's getting damned hot under here!"
"Jump my boy," said the electron,
"Your pants are beginning to sear."

Said A. J. B. to the electron,
"I didn't mean to run into the man!"
"Take a hint from me," said the electron,
"Keep out of crowds whenever you can."

Said A. J. B. to the electron,
"Oh boy, look at the fem over there!"
"The attraction is mutual," said the electron,
"Run meet her, then please disappear!"

PERRY R. STOUT
Kearney Foundation of Soil Science, University of California, Berkeley

E. G. Boring asks whether I want the teacher of science *never* to depart from the language of science. Now, *never* is an absolute, and it is difficult indeed to subscribe to an absolute. I would prefer to say that, so long as he purports to communicate the scientists' way of looking at the universe, the teacher of science would do well to avoid expressions inconsonant with that aim. Personally, I find it difficult to change as I move from classroom to luncheon table, and it seems dangerous to assume that the reverse change, between lunch and class, would be easier. It does not follow that avoiding teleology betrays a belief "that the scientific view of the world is the true view" (whatever "true view" may mean). Teachers of other disciplines present *their* views of the world and the "truth"; each contributes to a liberal education, and I would not dilute the contribution of the science teacher by conceding that his approach need not be thoroughly disciplined. This does not imply the superiority of one intellectual discipline over another.

We are agreed that language should be used with wisdom, good judgment, delicacy, and urbanity, but I do not see that precision and rigor are incompatible with these requirements. Unlike Boring, I am not confident that "scientific context" will develop proper attitudes irrespective of the choice of words. The modes of thought instilled in the student are, I maintain, due to the words. Schrödinger [*What Is Life? and Other Scientific Essays* (Doubleday, Garden City, N.Y.,

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1956), p. 146] puts its very well: "In the inseparable union of speech and thought the primacy, rather paradoxically, rests with speech. When we hear the same words again and again pronounced with authority, we are apt to forget that they were originally meant as an abbreviation; we are induced to believe that they describe a reality."

Between Powers and myself there seems to be no disagreement—we will not teach teleological thinking in those areas where we insist that teleology is to be avoided. If teleological thinking becomes fruitful in certain areas, we hope that teaching in those areas will become appropriately oriented. I suspect, however, that such teleology as he describes will need to be presented at a considerably more sophisticated level than the examples I cited.

As for natural laws and the presupposition of a lawgiver, I can do no more than expose my thinking. Briefly, and therefore with oversimplification, I consider a natural law as a generalization of our observations. As such, each presupposes a "law-stater," hence Hooke's law, Boyle's law, and so on. The idea of a lawgiver has always seemed to me to derive from a mistaken analogy with juridical law. If, *from the viewpoint of science,* it is meaningful to presuppose a lawgiver of natural laws, I shall be grateful to hear the argument.

There seems to be no essential disagreement between my article and Simpson's letter. Simpson feels that "teleonomy" is a valid orientation to biology and would defend such expressions; I offered no argument against any philosophy, be it teleology or teleonomy, that one may *deliberately* include in his teaching. But even if one's convictions in favor of teleonomy lead to language such as I quoted, which way will the student bend—toward vitalism, naive teleology, and animism or toward teleonomy? Simpson thinks that the context from which some of my excerpts came would serve to controvert naive teleology and to inculcate teleonomy. Perhaps, but the naive, even primitive, attitudes I discover in students do not leave me optimistic.

Said Stout to the interphase nucleus,
"I'm tired, I've been going all day."
And the nucleus wearily answered,
"Me too; I'm for hitting the hay!"

Perry Stout's discovery of poetry (?) showing anthropomorphic wording at its ludicrous extreme is a device not unlike the idea I received from Julius Roth of the University of Chicago. Roth suggests cartoons, with quotations from texts as the captions. The possibilities are endless—at least until they reach an editor!

ALBERT J. BERNATOWICZ
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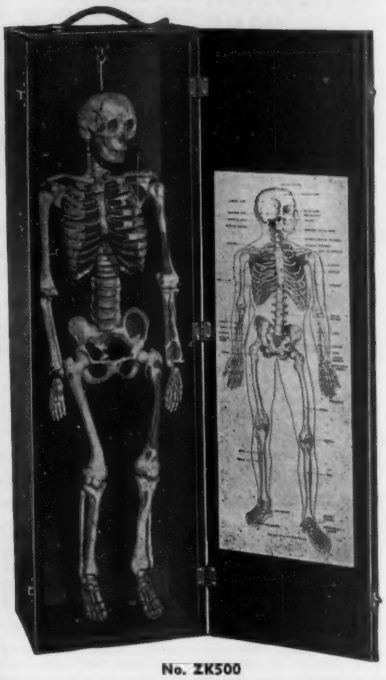

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Ph.D., Biochemistry; 5 years, analytical chemist; process control section, large industrial company, East. Medical Bureau, Burneice Larson, Director, 900 North Michigan Avenue, Chicago. X

Research Assistant, B.S.; 8 years of industrial pharmaceutical research experience with radioisotopes, pharmacodynamics, endocrinology, cancer. Publications. Desires challenging industrial or academic position. Box 47, SCIENCE. X

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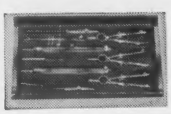

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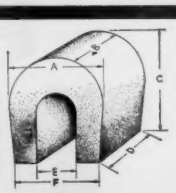

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6406-K. Complete with Periscopic Reader

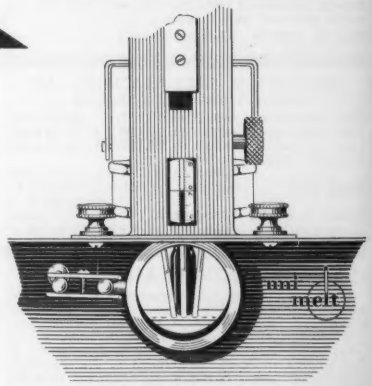
For fast reproducible determinations of melting points conforming to official U.S.P. and similar methods using glass capillary tubes. Electrically heated, range from room temperature to 350°C. Takes up to five samples simultaneously.

Consisting of illuminated, silicone fluid bath with electric stirrer, lagless heater controlled by autotransformer, built-in capillary vibrator, armored thermometer, etc., combined in a single sturdy unit.

PERISCOPIC THERMOMETER READER

Provides magnified thermometer indication in window adjacent to capillary magnifier, for ease in observation of both bath temperature and melting sample.

Upper mirror assembly of periscope is raised or lowered to follow mercury level of thermometer by turning knob at side of reader housing.



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Safety—Bath enclosed in cabinet except for observation port which is shielded by the magnifier. Removal of bath automatically disconnects heater and stirrer.

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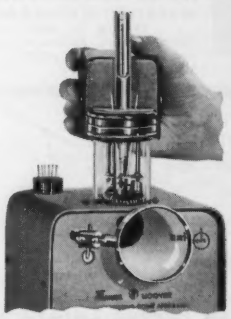
Capillary Vibrator—Recessed in top of housing. Shakes capillaries thoroughly, insuring uniform packing of sample.

A 100 ml beaker of borosilicate glass is used as the melting point bath. Bath is protected from dust and air currents by being completely contained within the instrument case. Oil in bath is circulated by an electrically driven stirrer with speed controlled from the instrument panel. Instrument is housed in a gray metal case, with thermometer protected by metal guard. For ease in changing the bath liquid, bath assembly including stirrer and thermometer can be lifted out of the cabinet.



6406-H. Showing bath unit lifted out of cabinet

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